Part 25—Airworthiness Standards: Transport Category Airplanes

This change incorporates Amendment 25–83, Improved Flammability Standards for Materials Used in the Interiors of Transport Category Airplane Cabins, adopted January 24, 1995. This final rule revises § 25.853 and Part IV of Appendix F. Bold brackets appear around revised and added material.

Page Control Chart

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Suggest filing this transmittal at the beginning of the FAR. It will provide a method for determining that all changes have been received as listed in the current edition of AC 00–44, Status of Federal Aviation Regulations, and a check for determining if the FAR contains the proper pages.

The rule will have little or no impact on trade for either U.S. firms doing business in foreign countries or foreign firms doing business in the United States. Foreign air carriers are prohibited from operating between points within the United States. Therefore, they will not gain any competitive advantage over U.S. carriers. In international operations, foreign air carriers are not expected to realize any cost advantage over U.S. carriers because the differential in costs between the existing and new ELT rule will not be significant enough to have an adverse impact on the international operations of U.S. carriers. Further, general aviation operations conducted in the United States are not in any direct competition with foreign enterprises. For these reasons, the FAA does not expect that the rule will result in any international trade impact.

Federalism Implications

The regulations herein will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this final rule does not(hive sufficient feleralism implications to warrant the prmparation of a Federalism Assessment.

Conclusion

The FAA has determined that the potential benefits of the regulation outweigh its potential costs and that it is not a significant regulatory action under Executive Order 12866. In addition, this rule will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. This rule is considered significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979) because it concerns a matter of substantial public interest. A regulatory evaluation of the rule, including a Regulatory Flexibility Determination and an International Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under "FOR FURTHER INFORMATION CONTACT."

The Amendments

In consideration of the foregoing, the Federal Aviation Administration amends 14 CFR parts 25, 29, 91, 121, 125, and 135 effective June 21, 1994.

The authority citation for part 25 is revised to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g).

Amendment 25–83

Improved Flammability Standards for Materials Used in the Interiors of Transport Category Airplane Cabins

Adopted: January 24, 1995 **Effective: March 6, 1995**

(Published in FR 6616, February 2, 1995)

SUMMARY: These amendments clarify standards adopted in 1986 concerning the flammability of components used in the cabins of certain transport category airplanes. This action is being taken to preclude costly, unintended changes to airplane interiors. The clarifications, which are applicable to air carriers, air taxi operators and commercial operators, as well as manufacturers of such airplanes, will result in more appropriate, consistent application of those standards.

25–61 and 121–189 (51 FR 26206, July 26, 1986) were adopted to upgrade the flammability standards for materials used in the interiors of transport category airplanes. The improved flammability standards were developed following a research and development program managed and conducted primarily at the FAA Technical Center in Atlantic City, New Jersey, to study aircraft fire characteristics and develop practical test methods. Among the tests conducted at the Technical Center were full-scale fire tests using the fuselage of a military C–133 configured to represent a wide-body jet transport airplane. The test conditions simulated representative post-crash external fuel-fed fires. Numerous laboratory tests were also conducted to correlate possible material qualification test methods with the full-scale tests. As a result of those tests, the Ohio State University (OSU) radiant rate-of-heat-release apparatus was determined to be the most suitable for material qualification. These tests led to the adoption of Amendment 25–61.

Amendment 25–61 established flammability standards for transport category airplanes with passenger seating capacities of 20 or more and specified the test method and apparatus to be used in showing compliance with those standards. It specified that interior ceiling and wall panels (other than lighting lenses), partitions, and the outer surfaces of galleys, large cabinets and stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must meet the new standards. As outlined in the amendment, an average of three or more test specimens must not exceed 65 kilowatts per square meter peak heat release nor 65 kilowatt minutes per square meter total heat release during the first two minutes of sample exposure time (65/65) when tested using the OSU test apparatus. These acceptance criteria were chosen in order to produce a significant retardation of the flashover event which controls occupant survivability, as experienced in the full-scale testing. (Burning cabin materials give off unburned gases that collect in the upper portions of the cabin. After a very short time, these unburned gases are heated to the point where they ignite and burn instantaneously. When this occurs, the temperature in the whole cabin becomes so hot that survival is impossible for anyone remaining in the cabin. This phenomenon, known as flashover, also makes further survival impossible by consuming the oxygen in the cabin.)

Because Amendment 25–61 applies explicitly only to airplanes for which an application for type certificate is made after August 20, 1986, Amendment 121–189 to part 121 of the FAR was also adopted to require operators of certain other airplanes used in air carrier or commercial service to meet the new 65/65 standards. Those airplanes must meet the new standards if they were newly manufactured after August 19, 1990. Airplanes type certificated on or after January 1, 1958, and manufactured prior to August 20, 1990, must also comply with the new standards upon the first substantially complete replacement of the specified cabin interior components on or after the latter date.

Although part 135 was not amended at that time, air taxi and commercial operators of large airplanes are required to comply as well because § 135.169 incorporated the newly adopted provisions of part 121 by reference.

At the time the amendments were adopted, the FAA understood that some persons were planning to install components which, even though they would meet the previously existing requirements of part 25 for flammability, were more flammable than the components that were in general use at that time. In order to preclude a possible degradation in the flammability characteristics of the cabin interiors, Amendment 121–189 also established interim standards of 100 kilowatts per square meter peak heat release and 100 kilowatt minutes per square meter total heat release (100/100). The interim standards are applicable to airplanes manufactured during the two-year period prior to August 20, 1990; and, unless there is a substantially complete replacement of the specified cabin interior components after August 19, 1990, they will remain applicable to those airplanes as long as they are operated under the provisions of part 121 or part 135. (If there is a substantially complete replacement on or after August 19, 1990, the definitive 65/65 standards would be applicable.) In addition, the interim standards are also applicable to airplanes in which there is a substantially complete replacement of the specified interior components during that two-year period.

remains applicable to airplanes in which there has not been a substantially complete replacement of the cabin interior since August 19, 1988, and to airplanes with 19 or fewer passengers.

The date of manufacture, as used in § 121.312, is the date on which inspection records show that an airplane is in a condition for safe flight. This is not necessarily the date on which the airplane is in conformity to the approved type design, or the date on which a certificate of airworthiness is issued, since some items not relevant to safe flight, such as passenger seats, may not be installed at that time. It could be earlier, but would be no later than the date on which the first flight of the airplane occurs.

For reasons discussed in the preamble to that amendment, Amendment 25–66 was adopted (53 FR 37542, September 27, 1988) to make minor refinements in the test procedures and apparatus required to show compliance with the standards adopted by Amendment 25–61 and to add a requirement for smoke testing. Amendment 121–198, which was adopted at the same time, added a provision allowing deviations to be granted for certain components.

In the preamble to Amendment 25–61, the FAA noted that the new heat release standards apply to all large-surface cabin interior components, such as sidewalls, ceilings, bins and partitions, and galley structures. It was also noted that the new standards do not apply to smaller items because their small masses would preclude significant contributions to the total heat release in the cabin area. The FAA has received a number of requests for clarification as to the maximum size a component may be without having to comply with the new heat release standards.

The distinction between parts with large surface areas, which must meet the new standards, and those with smaller surface areas is very difficult because of the size of the cabin and other factors that may vary from one airplane to another. For example, a specific component might be insignificant when installed in a large wide-body airplane because it would make a minor contribution to the overall flammability of the area of the cabin in which it is installed. On the other hand, it might represent a major contribution when installed in a smaller transport category airplane. The proximity of the component to a potential source of fire, such as an exit or galley, is also a consideration. It is not possible to cite a specific size that will apply in all installations; however, as a general rule, components with exposed-surface areas of one square foot or less may be considered small enough that they do not have to meet the new standards. Components with exposed-surface areas greater than two square feet may be considered large enough that they do have to meet the new standards. Those with exposed-surface areas greater than one square foot, but less than two square feet, must be considered in conjunction with the areas of the cabin in which they are installed before a determination could be made.

Discussion

Since the time Amendments 25–61 and 121–189 were adopted, the FAA became aware of four areas in which the wording of the new rules does not clearly reflect the intent of the agency as discussed in the preamble to those amendments. Because the new rules do not clearly reflect the intent in those areas and because the comments that were received may have been based on the intent, as expressed in the preambles, rather than the literal wording of the rules, the following clarifications were proposed in Notice 90–12.

Cabin windows and clear vision panels in cabin partitions: The preamble to Amendments 25–61 and 121–189 states, "The new flammability standards do not apply to transparent or translucent components such as lenses used in interior lights and illuminated signs, and window anti-scratch panels, because of the lack of materials which will meet the flammability standards and still have the light transmissibility characteristics which are vital in emergency situations." Although not specifically mentioned in the earlier rulemaking, transparent panels are sometimes inserted in cabin partitions to enhance cabin safety. For example, they are sometimes used to provide seated flight attendants a clear, unobstructed view of the cabin or to provide passengers a view of an exit as an aid to an emergency evacuation. As in the case of lighting lenses and windows, the need for transparent partition panels that enhance cabin safety

Galleys: As currently worded, § 25.853(a–1) states that the new flammability standards apply to the "outer surfaces of galleys." This phrase was intended to make an exception for the interior surfaces of galley cabinets, etc., that would not be exposed to a cabin fire. It is ambiguous, however, because most galleys are not isolated from the main cabin by a door. While one might consider the surfaces of a galley working are to be "inner surfaces," they are actually outer surfaces in most installations in the sense that they could be exposed to a cabin fire. In addition, the inner walls of the galley cart cavity or standard container cavity may also be exposed on some lightly loaded flights when there is not a full complement of carts or containers on board. In order to preclude any confusion in this regard, it was proposed that § 25.853(a–1) would be amended to clarify that any galley surface exposed to the passenger cabin must meet the new standards.

Isolated compartments: Unlike previously existing paragraphs (a) and (b) of § 25.853, the new flammability standards of paragraph (a–1) were intended to apply only to the passenger cabin and not to compartments that are isolated from the passenger cabin. Due, however, to the organization of § 25.853(a–1), if taken literally, the new standards also pertain to each compartment occupied by crew (including one occupied only on a temporary basis) or passengers regardless of whether the particular compartment is isolated from the passenger cabin.

Neither the research and development program nor the regulatory evaluations on which the new flammability standards were based considered that compartments isolated from the passenger cabin (or cabins in the case of airplanes with passenger cabins located on two different decks) would have to comply with the new standards. Unlike most galleys located in the main cabin, remote galleys and other compartments, such as lavatories, pilot compartments and crew rest or sleeping areas, are generally isolated from the passenger cabin by at least a door. In some instances, they are located on separate decks. They would, therefore, not be exposed to a cabin fire until well after flashover had occurred in the cabin and egress was no longer possible. Should an external fire enter the airplane at one of those compartments, the flammability of the materials used in them would not directly affect the cabin due to their isolation. As stated in the earlier rulemaking, the new standards address a post-crash, external fuel-fed fire situation. With the exception of the pilot compartment, it can be assumed that such compartments would not be occupied by passengers or crewmembers during a post-crash situation.

Although the rulemaking was undertaken to address a post-crash scenario, there is also the question of whether or not requiring the lavatories to meet the new flammability standards would enhance safety significantly in the event a fire originated in a lavatory during flight. This question is particularly pertinent in light of the recently adopted ban on smoking on domestic airline flights. Although some persons might be more tempted to smoke illicitly in a lavatory during such flights, the lavatory smoke detector required by recently adopted Amendment 121–185 (50 FR 12726, March 29, 1985) serves as a deterrent and provides warning of illicit smoking to the crew. In addition, the new standards would not apply to many of the components in a lavatory due to their small size. The doors and most sidewalls have to meet the new standards regardless of whether the new standards are applicable to lavatories because their outer sides also form surfaces of the passenger cabin. Some portions of the lavatory are generally constructed of fireproof stainless steel due to functional considerations. Requiring the few remaining large components to meet the new standards would have very little impact on the overall flammability of the lavatory and would not significantly enhance safety in the event of an inflight fire.

Pilot compartments are generally isolated from the passenger cabin by a bulkhead and door. Although they are obviously occupied full-time, requiring them to meet the new standards would not significantly enhance safety in the event of an inflight fire for essentially the same reasons. Pilot compartments are generally constructed of many small components which would not have to meet the new standards due to their small size. The bulkhead and entry door have to meet the new standards regardless of whether they are applicable to the pilot compartment because the aft sides of those components also form surfaces of the passenger cabin. As in the case of the lavatories, requiring the few remaining large components to meet the new standards would have very little impact on the overall flammability of the pilot compartment. Although there is no smoke detector required, a fire would be detected immediately by the flight crew-considered to be service items; however, unlike the items cited in the preamble statement, they are generally approved as part of the airplane type design. Although the new flammability standards do not apply expressly to galley carts, it was intended that they would apply implicitly to the extent that, when stowed, the galley carts form exterior surfaces of the galley. Typically, at least one end of each cart remains exposed and forms a galley surface while the cart is stowed. In addition to galley carts, these are galley standard containers used for various meal courses, beverages, plates, etc., that also form galley surfaces when stowed.

Operators have pointed out that galley carts are removable items that are rotated from one airplane to another with each flight. In this regard, they note that their fleets will include older airplanes that are not required to meet the new standards, as well as new airplanes (or airplanes in which the interiors have been replaced) that will be required to meet the new standards. They further note that the carts are loaded before a flight by persons, usually independent caterers, who have no way of knowing whether or not the airplane that will be used on a particular flight is required to meet the new standards. Unless all existing noncomplying galley carts are replaced with galley carts that meet the new standards, there is no practical means to ensure that galley carts meeting the new standards will be loaded on the airplanes that are required to have them. It is estimated that there are now approximately 125,000 galley carts in use with the U.S. air carrier fleet. Typically, the cost per cart ranges from $800 to $3,500; and the service life is about eight to ten years. While it is feasible to replace the existing carts on an attrition basis, it would be impractical to produce enough galley carts meeting the new standards in time to meet the established deadlines. In addition, such immediate replacement would be very costly. The operators note that they would have commented accordingly had they not believed that, as service items, galley carts did not have to meet the new standards.

The galley standard containers are also rotated from airplane to airplane; and they, too, are filled prior to the flight by persons who have no way of knowing whether the airplane that will be used on the flight is one required to meet the new standards. While the cost of each galley standard container would be less than that of a beverage cart, replacing the entire inventory of containers would be very costly.

Although it was intended that the exposed surfaces of stowed galley carts and standard containers should meet the new standards, the FAA has concluded, upon further review, that it was not clearly stated that the galley carts and containers would be required to comply. The FAA does, however, consider that the exposed surfaces of stowed galley carts and standard containers must ultimately meet the new flammability standards. It was, therefore, proposed that § 25.853(a–1) would be amended to specifically require the exposed surfaces of those components to meet the new standards.

The FAA concurs that unless all carts and containers are replaced, it would be extremely difficult to ensure that galley carts and standard containers meeting the new standards are loaded on the airplanes that are required to meet them. Furthermore, the immediate replacement of all galley carts and standard containers would be logistically impossible and would present an unreasonable economic burden. If, on the other hand, galley carts and standard containers that meet the new standards are acquired at a rate commensurate with the rate at which new airplanes are acquired (and interiors of older airplanes are replaced), it can be assumed that the overall level of safety of the air carrier fleet will not be adversely affected by intermixing carts and containers complying with the new standards with those that do not. The small decrement of safety that would be suffered due to the use of noncomplying carts and containers in an airplane that must meet the new standards would be compensated by an increment of safety enjoyed due to the use of complying carts and containers in another airplane that is not required to meet them. It was, therefore, proposed that § 121.312 would be amended to allow such intermixing of galley carts and standard containers, provided that all carts and containers manufactured after a specified date meet the new standards.

Other changes: Certain minor refinements in the test apparatus and procedures were identified; and it was proposed that appendix F of part 25, including the associated figures, would be revised accordingly. The proposed refinements would not preclude the use of materials previously found to be acceptable

In order to preclude any confusion in this regard, it was proposed that part 135 would be amended to include the new standards explicitly rather than by reference. Because part 135 operators are already required to meet these standards due to the incorporation by cross reference, this change would not place any additional burden on any person.

The reference to "November 26, 1987" in § 121.312(b) is no longer relevant because that date has already passed. It would, therefore, be removed for simplification. The redundant reference to appendix F of part 25 would also be removed from § 121.312(b) for simplification and consistency with the editorial style used in § 121.312(a). (Appendix F, part II, is incorporated by cross reference in § 25.853(c); and appendix F, part IV, is incorporated by cross reference in § 25.853(a–1).)

Since the time Notice 90–12 was issued, Amendment 25–72 was adopted (55 FR 29756, July 20, 1990). Although no substantive changes to § 25.853 were adopted, the requirements of that section were rearranged considerably for clarity, and the test acceptance criteria formerly contained in that section were transferred to part I of appendix F. It is, therefore, necessary to make a number of nonsubstantive conforming changes for consistency with § 25.853 in its present format.

Among the changes made to § 25.853 as a result of the adoption of Amendment 25–72 was the transfer of the seat cushion flammability standards from former § 25.853(c) to new § 25.853(b). It has been brought to the attention of the FAA that this change is causing considerable confusion. Seats are frequently transferred from one airplane to another; therefore, as a practical matter, they must be marked to show that their cushions comply with the flammability standards. With the change in section number, the previous markings indicating compliance with § 25.853(c) are no longer accurate. In order to eliminate further confusion in that regard, § 25.853(b) has been marked "Reserved," and the seat cushion flammability standards have been transferred back to § 25.853(c).

For convenience, the proposed changes to § 25.853 are discussed below both in terms of their identity in Notice 90–12 and as rearranged for conformity with the changes resulting from the adoption of Amendment 25–72.

Discussion of Comments

Seven commenters responded to the request for comments contained in Notice 90–12. These included manufacturers, a foreign airworthiness authority, and organizations representing manufacturers, airlines, and airline employees.

One commenter notes that the restructuring and numbering of § 25.853 may have inadvertently excluded such items as lighting lenses, windows, transparent panels needed to enhance cabin safety, etc., from compliance with any of the flammability standards of § 25.853. The FAA concurs that the wording proposed in Notice 90–12 could have led to an incorrect interpretation of that nature. Section 25.853 is, therefore, changed by transferring the statement "Except as provided . . ." to § 25.853(d), which would have been § 25.853(a–1) as proposed in Notice 90–12.

One commenter opposes the proposal to clarify that compartments isolated from the cabin are not required to meet the heat release standards of § 25.853(a–1). The commenter states that all compartment components should be of the same standard and that meeting the same standard would ensure that the net amount of material contributing to fire development and propagation is at the absolute minimum. In that regard, the commenter cites the accident involving a McDonnell Douglas DC–9 operated by Air Canada on June 2, 1983, at the Greater Cincinnati Airport, Covington, Kentucky. The commenter notes that, while the origin of the fire that destroyed the airplane could not be identified, the lavatory compartment's interior material was the primary source of fuel and that the fire burned undetected for almost 15 minutes before the smoke was first noticed. The commenter asserts that requiring the compartment to meet the same low heat release standards as the main cabin would significantly reduce the amount of fuel available for such a fire.

safety in the event of an inflight fire.

In the accident cited by the commenter, smoke was discovered coming from the left-hand lavatory in the aft cabin while the airplane was enroute from Dallas, Texas to Montreal, Quebec. An emergency landing was not made until 17 minutes later. By that time, the fire and smoke had grown in intensity to the point that only half of the 46 occupants were able to escape. As noted in their official accident report, NTSB/AAR–86/02, the National Transportation Safety Board determined that the probable causes of the accident were a fire of unknown origin, an underestimate of the fire severity, and misleading fire progress information provided to the captain. Considering the few lavatory components that would be affected and the time that the fire had been burning prior to the emergency landing, it is unlikely that the outcome of the accident would have been more favorable if the lavatory of that airplane had met the new heat release standards.

Subsequent to the accident, the FAA adopted Amendments 25–58 and 121–183 (49 FR 43182, October 26, 1984), and 25–59 and 121–184 (49 FR 43188, October 26, 1984), that require, respectively, low-level lighting to enable occupants to locate emergency exits in smoke-filled cabins and new flammability standards for seat cushions. Unlike the heat release standards of Amendment 25–61, the new flammability standards for seat cushions are designed to slow the progression of a fire through the cabin. The standards of Amendment 25–61 are, on the other hand, designed to reduce the overall release of heat into the cabin during a post-crash fire situation and provide more time for egress before flashover makes further escape impossible. Amendment 121–185 (50 FR 12726, March 29, 1985) was also adopted to require each lavatory to be equipped with a smoke detection system, or equivalent, and a fire extinguisher that discharges automatically upon the occurrence of a fire in the trash receptacle. In addition, the amendment requires the passenger cabins of certain airplanes to be equipped with additional hand fire extinguishers, some of which must contain the improved agent Halon 1211.

The commenter also notes that all compartments with essential systems adjacent to their surfaces should be required to meet the heat release standards of § 25.853(a–1) in order to protect the essential conductors of those systems from the high heat releases of burning interior materials.

The commenter appears to be confusing the standards for heat release with other standards for flame resistance. As noted above, the heat release standards are designed to reduce the overall release of heat into an area and thereby delay the time until flashover occurs. It is assumed, on the other hand, that the insulation of electrical wiring and cables could be enveloped by flame. They must, therefore, be tested by actual application of flame to the insulation surface.

The same commenter recommends that, if an isolated compartment does not have to meet the heat release standards, the doors separating the compartment from the main cabin should be able to contain the heat and smoke in the isolated compartment for at least five minutes. (Such doors would be 'fire-resistant' as defined in part 1 of the FAR.)

The commenter's recommendation is apparently based on the assumption that there will be an uncontrollable fire originating from an isolated compartment. In view of the fire protection measures that have been adopted for lavatories since the above noted accident, there is no evident need for fire-resistant lavatory doors. Furthermore, service history does not support a need for such doors to other isolated compartments. The exception proposed as § 25.853(a–2) is, therefore, adopted as § 25.853(e).

One commenter recommends that § 25.853(a–1)(1) be amended to read, "other than lighting lenses, illuminated signs and windows," since illuminated signs are discussed in the preamble to Notice 90–12 as examples of excluded items. While it is true that the illuminated portions of passenger information signs are not required to meet the heat release standards of that section, it is not necessary to refer to them specifically in § 25.853(a–1)(1) because they are "lighting lenses." Proposed § 25.853(a–1)(1) is adopted as § 25.853(d)(1).

The same commenter and one other recommend that § 25.853(a–2) be clarified by adding "lavatories" to the list of compartments whose interiors are excluded. Unlike the illuminated signs discussed above, standards of § 25.853(c) are also applicable only to airplanes with 20 or more passengers. To preclude any confusion in this regard, the phrase, "regardless of the passenger capacity of the airplane," has been added to § 25.853(a) and (c).

Another commenter suggests that part IV of appendix F should be amended to permit the use of the optional 14-hole upper pilot burner that has been found satisfactory. Actually, the use of this optional burner has already been accepted by the FAA under the equivalent safety provisions of § 21.21(b)(1). The FAA notes that test data obtained during testing with the three-hole burner are sometimes invalidated because the pilot burner would not remain lighted for the entire 5-minute duration of the test. With the optional 14-hole burner, there is a greater probability of reigniting any flamelets that might extinguish during a test. Because the 14-hole burner may be preferable in some instances, part IV is amended to describe the optional use of that burner, as suggested by the commenter. Testing with this optional burner is already permitted under the equivalent safety provisions of § 21.21(b)(1); therefore, this is a minor nonsubstantive change that places no additional burden on any person.

Paragraph (b)(8) states that the pilot burners must remain lighted for the entire duration of the test. In regard to the difficulties experienced in keeping the three-hole upper pilot burner lighted for the entire duration of the test, the FAA proposed to add the statement, "Intermittent pilot flame extinguishment for more than 3 seconds would invalidate the test results." The same commenter notes that further clarification is required. According to the commenter, it is normal for some of the upper pilot-burner flamelets to be extinguished for periods that can exceed three seconds when samples containing flame retardants are tested. The commenter notes that the results of such tests have been considered acceptable provided some of the flamelets have remained lighted.

The FAA concurs that it is not necessary for each flamelet of the three-hole upper pilot burner to remain lighted for the entire 5-minute duration of the test; however, test results may be invalidated if two flamelets are unlighted for more than 3 seconds. In order to preclude, such intermittent flamelet extinguishment, the FAA has permitted applicants to install an igniter. Intermittent flame extinguishment has not posed a problem with the optional 14-hole upper pilot burner since it was developed to preclude flame extinguishment. Paragraph (b)(8) is, therefore, changed to read, "Since intermittent pilot flame extinguishment for more than 3 seconds would invalidate the test results, a spark igniter may be installed to ensure that the burners remain lighted." Paragraph (e)(8), which is considered a more appropriate location than paragraph (b)(8), is amended to clarify the requirements for burners and flamelets to remain lighted.

Part IV, paragraph (e)(3) states that the proper air flow may be set and monitored by either an orifice meter or a rotometer. Because of difficulties experienced in setting and monitoring the air flow with a rotometer, the FAA proposed in Notice 90–12 to amend that paragraph to refer only to an orifice meter. The same commenter cited the successful use of a rotometer by the National Research Council of Canada and recommended that the reference to a rotormeter be retained in that paragraph. While the use of a rotometer may be successful in some instances, the FAA does not have sufficient information at this time to conclude that a rotometer is acceptable on a general basis. It is, therefore, not considered appropriate to specifically cite the rotormeter in that paragraph as an acceptable alternative means of setting and monitoring air flow. The FAA does recognize, however, that rotometers, or any other devices for that matter, may be improved to the point that their use is acceptable. In that event, those devices could be used under the equivalent safety provisions of § 21.21(b)(1).

The same commenter notes that the area of .02323 m^2 specified in the heat release equation of paragraph (f)(2) is based on a test specimen size of 6 × 6 inches. Since the actual size of the sample is 150 × 150 mm, the commenter believes that an area factor of .0225 m^2 should actually be used in the heat release equation.

Although the commenter is technically correct, the definitive 65/65 and the interim 100/100 standards were established based on the use of a factor of .02323 m^2. Furthermore all testing completed to date has been based on the use of the .02323 factor. Changing the factor to .0225 at this late date would

Section 121.312(a) incorporates the heat release standards of § 25.853(a-1) by cross-reference. Since the latter section applies only to airplanes with passenger capacities of 20 or more, § 121.312(a) requires compliance with these heat release standards only for airplanes with passenger capacities of 20 or more. As one commenter notes, § 121.312(a) can be misinterpreted to require compliance for all transport category airplanes regardless of their passenger capacity. In order to preclude possible confusion in this regard, both § 121.312(a) and newly adopted § 135.170(b)(1) state specifically that compliance is required only for airplanes with passenger capacities of 20 or more.

Another commenter notes that § 121.312(a)(1) through (6) and the corresponding § 135.170(b)(1)(i) through (vi) are complex and difficult to understand. The FAA acknowledges that these sections are very complex. This is due primarily to the fact that there are differing requirements dependent on such factors as when the airplane was type certificated, when it was manufactured, when there was a substantially complete replacement of the cabin interior components, etc. There is even a distinction between complete replacement of all cabin interior components in one case and just those components identified in § 25.853(a–1) in another. The only way in which the provisions of these sections could be significantly simplified would be to require compliance for all airplanes at one time. While that would simplify the regulatory language considerably, it would impose costly additional burdens on some operators with no commensurate improvement in safety. Nevertheless, minor nonsubstantive changes have been made wherever possible to clarify these requirements.

Proposed § 121.312(a)(8) states, in part, that ". . . galley carts and galley standard containers that do not meet the heat release rate testing requirements . . . may be used . . . provided the galley carts or standard containers were manufactured prior to August 20, 1990." One commenter believes that this section should refer to galley carts and standard containers manufactured prior to a date two years after the effective date of this amendment.

The FAA concurs that it is inappropriate to specify a date earlier than the date on which this final rule becomes effective. The FAA does not, however, agree that an additional two-year compliance time is necessary. The amendment does not require galley carts and standard containers manufactured after the specified date to comply. Instead, it relieves operators of the burden of ensuring that only complying galley carts and standard containers are loaded on airplanes that are required to meet the new flammability standards *provided* the galley carts and standard containers are manufactured prior to that date. Section 121.312(a)(8) and the corresponding § 135.170(b)(viii) are, therefore, changed to read, ". . . provided the galley carts or standard containers were manufactured prior to March 6, 1995.

One commenter believes that there should be a specific definition of what constitutes "substantially complete replacement" as stated in § 121.312. The commenter expresses concern that the definition should allow for the individual replacement of cabin interior components without the mandatory replacement of all components at the same time.

"Complete replacement," as used in § 121.312 and newly adopted § 135.170(b), means that all of the affected components in the cabin are replaced. (As noted above under *Background*, whether the other components that are not affected, e.g. seat cushions and flooring, are replaced is not relevant.) The qualifying word "substantially" was added simply to prevent operators from avoiding compliance by not replacing a minor, inconsequential cabin component and claiming that there had not been a "complete replacement." Section 212.312 does, therefore, permit individual replacement of cabin interior components without the mandatory replacement of all components at the same time. This, of course, assumes that the cabin components did not already have to meet the heat release standards because of the date of manufacture of the airplane or because they had been completely replaced previously. It should also be noted that removing components for refinishing and reinstalling them in the same airplane is considered "refurbishment," not "replacement."

Proposed § 135.170(b) states, "No person may operate a large airplane unless . . ." Several commenters note that part 23 commuter category airplanes are "large airplanes," as defined by part 1 of the FAR, and, as such, would be required to meet the new flammability standards contained in that section. Another commenter has a similar concern that proposed § 135.170(b) would appear to add substantial requirements

Since neither commuter category airplanes nor those type certificated under the provisions of SFAR No. 41 are permitted to carry more than 19 passengers, there is no need to amend § 135.170(b) of specifically exclude those airplanes. Specifically stating in §§ 121.312(a) and 135.170(b)(1) that only airplanes with 20 or more passengers seats are required to comply, as discussed above, will preclude confusion in this regard.

One commenter reiterates a belief that the seat cushion flammability standards of § 25.853(c) are an unnecessary burden for operators of small transport category airplanes with passenger seating capacities of fewer than 19 passengers. The commenter is referring in this regard to the provisions of § 121.312 which were previously incorporated by cross reference in § 135.169 and now are stated explicitly as new § 135.170(b)(2). Section 121.312(b) and the new § 135.170(b)(2), in turn specify that the operator must have seat cushions that meet the flammability standards of § 25.853(c). That issue has already been addressed by FAA in earlier rulemaking and is not related, in any substantive manner, to the present rulemaking.

Another commenter notes an inadvertent error in proposed § 135.169(a) in that it would incorporate § 121.311 by cross reference. The intent was to move the no longer needed reference to § 121.312, not to replace it with § 121.311. Section 135.169(a) is corrected accordingly.

Regulatory Evaluation

Regulatory Evaluation

Exeuctive Order 12291, dated February 17, 1981, directs Federal agencies to promulgate new regulations or modify existing regulations only if potential benefits to society for each regulatory change outweigh potential costs. This section summarizes the full regulatory evaluation prepared by the FAA that provides more detailed estimates of the economic consequences of this regulatory action.

The evaluations prepared for Amendments 25–61 and 121–189, and Amendments 25–66 and 121–198 remain unchanged by this rule with respect to costs and benefits, regulatory flexibility determinations, and trade impact assessment.

None of the amendments in this rule will generate significant costs or benefits. In part, the rule clarifies the original intent of the earlier amendments. The changes to the test apparatus and procedures for determining heat release rate are minor refinements that will result only in negligible costs and benefits. The amendment to part 135 is a nonsubstantive change that incorporates existing requirements explicitly rather than by cross reference. The remaining changes are editorial or conforming in nature.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1989 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by Government regulations. The RFA requires a Regulatory Flexibility Analysis if a rule has a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, established threshold cost values and small entity size standards for complying with RFA review requirements in FAA rulemaking actions. The FAA has determined that this rule will not have a significant economic impact on a substantial number of small entities.

International Trade Impact Analysis

This rule will not have an adverse impact either on the trade opportunities of U.S. operators or manufacturers of transport category airplanes doing business abroad, or on foreign operators or aircraft manufacturers doing business in the United States.

Because the regulations adopted herein are expected to result only in negligible costs, the FAA has determined that this final rule is not major as defined in Executive Order 12291. Because this is an issue that has not prompted a great deal of public concern, this final rule is not considered to be significant as defined in Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). In addition, since there are no small entities affected by this rulemaking, it is certified, under the criteria of the Regulatory Flexibility Act, that this final rule, at promulgation, will not have a significant economic impact, positive or negative, on a substantial number of small entities. The regulatory evaluation prepared for Amendments 25–66 and 121–198 remains applicable and has been placed on the docket. A copy of this evaluation may be obtained by contacting the person identified under the caption ''FOR FURTHER INFORMATION CONTACT.''

Adoption of the Amendment

Accordingly, 14 CFR parts 25, 121 and 135 of the Federal Aviation Regulations (FAR) are amended effective March 6, 1995.

The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g).

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§ 25.601 General.

The airplane may not have design features or details that experience has shown to be hazardous or unreliable. The suitability of each questionable design detail and part must be established by tests.

§ 25.603 Materials.

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—

(a) Be established on the basis of experience or tests;

(b) Conform to approved specifications (such as industry or military specifications, or Technical Standard Orders) that ensure their having the strength and other properties assumed in the design data; and

(c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.

(Amdt. 25–38, Eff. 2/1/77); (Amdt. 25–46, Eff. 12/1/78)

§ 25.605 Fabrication methods.

(a) The methods of fabrication used must produce a consistently sound structure. If a fabrication process (such as gluing, spot welding, or heat treating) requires close control to reach this objective, the process must be performed under an approved process specification.

(b) Each new aircraft fabrication method must be substantiated by a test program.

(Amdt. 25–46, Eff. 12/1/78)

§ 25.607 Fasteners.

(a) Each removable bolt, screw, nut, pin, or other removable fastener must incorporate two separate locking devices if—

(1) Its loss could preclude continued flight and landing within the design limitations of the airplane using normal pilot skill and strength; or

yaw, or roll control capability or response below that required by subpart B of this chapter.

(b) The fasteners specified in paragraph (a) of this section and their locking devices may not be adversely affected by the environmental conditions associated with the particular installation.

(c) No self-locking nut may be used on any bolt subject to rotation in operation unless a non-friction locking device is used in addition to the self-locking device.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.609 Protection of structure.

Each part of the structure must—

(a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—

(1) Weathering;

(2) Corrosion; and

(3) Abrasion; and

(b) Have provisions for ventilation and drainage where necessary for protection.

§ 25.611 Accessibility provisions.

Means must be provided to allow inspection (including inspection of principal structural elements and control systems), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Nondestructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required in § 25.1529.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.613 Material strength properties and design values.

(a) Material strength properties must be based on enough tests of material meeting approved speci-

(1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in loss of structural integrity of the component, 99 percent probability with 95 percent confidence.

(2) For redundant structure, in which the failure of individual elements would result in applied loads being safely distributed to other load carrying members, 90 percent probability with 95 percent confidence.

(c) The effects of temperature on allowable stresses used for design in an essential component or structure must be considered where thermal effects are significant under normal operating conditions.

(d) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.

(e) Greater design values may be used if a ''premium selection'' of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.

(Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–72, Eff. 8/20/90)

§ 25.615 [Removed]

§ 25.619 Special factors.

The factor of safety prescribed in § 25.303 must be multiplied by the highest pertinent special factor of safety prescribed in §§ 25.621 through 25.625 for each part of the structure whose strength is—

(a) Uncertain;

(b) Likely to deteriorate in service before normal replacement; or

(c) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

(Amdt. 25–23, Eff. 5/8/70)

of hydraulic or other fluid systems and do not support structural loads.

(b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—

(1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used; and

(2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.

(c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the airplane or result in serious injury to occupants, the following apply:

(1) Each critical casting must—

(i) Have a casting factor of not less than 1.25; and

(ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle or penetrant inspection methods or approved equivalent nondestructive inspection methods.

(2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—

(i) The strength requirements of § 25.305 at an ultimate load corresponding to a casting factor of 1.25; and

(ii) The deformation requirements of § 25.305 at a load of 1.5 times the limit load.

(3) Examples of these castings are structural attachment fittings, parts of flight control systems, control surface hinges and balance weight attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.

(d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply:

(1) Except as provided in paragraphs (d)(2) and (3) of this section, the casting factors and corresponding inspections must meet the following table:

Casting factor	*Inspection*
2.0 or more	100 percent visual.

nonvisual methods may be reduced below that specified in paragraph (d)(1) of this section when an approved quality control procedure is established.

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

(i) A casting factor of 1.0 may be used; and

(ii) The castings must be inspected as provided in paragraph (d)(1) of this section for casting factors of "1.25 through 1.50" and tested under paragraph (c)(2) of this section.

§ 25.623 Bearing factors.

(a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.

(b) No bearing factor need be used for a part for which any larger special factor is prescribed.

§ 25.625 Fitting factors.

For each fitting (a part or terminal used to join one structural member to another), the following apply:

(a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

(1) The fitting;

(2) The means of attachment; and

(3) The bearing on the joined members.

(b) No fitting factor need be used—

(1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood); or

(2) With respect to any bearing surface for which a larger special factor is used.

§ 25.629 [Aeroelastic stability requirements.

[(a) *General.* The aeroelastic stability evaluations required under this section include flutter, divergence, control reversal and any undue loss of stability and control as a result of structural deformation. The aeroelastic evaluation must include whirl modes associated with any propeller or rotating device that contributes significant dynamic forces. Compliance with this section must be shown by analyses, wind tunnel tests, ground vibration tests, flight tests, or other means found necessary by the Administrator.

[(b) *Aeroelastic stability envelopes.* The airplane must be designed to be free from aeroelastic instability for all configurations and design conditions within the aeroelastic stability envelopes as follows:

[(1) For normal conditions without failures, malfunctions, or adverse conditions, all combinations of altitudes and speeds encompassed by the V_D/M_D versus altitude envelope enlarged at all points by an increase of 15 percent in equivalent airspeed at both constant Mach number and constant altitude. In addition, a proper margin of stability must exist at all speeds up to V_D/M_D and, there must be no large and rapid reduction in stability as V_D/M_D is approached. The enlarged envelope may be limited to Mach 1.0 when M_D is less than 1.0 at all design altitudes, and

[(2) For the conditions described in § 25.659(d) below, for all approved altitudes, any airspeed up to the greater airspeed defined by;

[(i) The V_D/M_D envelope determined by § 25.335(b); or,

[(ii) An altitude-airspeed envelope defined by a 15 percent increase in equivalent airspeed above V_C at constant altitude, from sea level to the altitude of the intersection of 1.15 V_C with the extension of the constant cruise Mach number line, M_C, then a linear variation in equivalent airspeed to M_C + .05 at the altitude of the lowest V_C/M_C intersection; then, at higher altitudes, up to the maximum flight altitude, the boundary defined by a .05 Mach increase in M_C at constant altitude.

[(1) Any critical fuel loading conditions, not shown to be extremely improbable, which may result from mismanagement of fuel.

[(2) Any single failure in any flutter damper system.

[(3) For airplanes not approved for operation in icing conditions, the maximum likely ice accumulation expected as a result of an inadvertent encounter.

[(4) Failure of any single element of the structure supporting any engine, independently mounted propeller shaft, large auxiliary power unit, or large externally mounted aerodynamic body (such as an external fuel tank).

[(5) For airplanes with engines that have propellers or large rotating devices capable of significant dynamic forces, any single failure of the engine structure that would reduce the rigidity of the rotational axis.

[(6) The absence of aerodynamic or gyroscopic forces resulting from the most adverse combination of feathered propellers or other rotating devices capable of significant dynamic forces. In addition, the effect of a single feathered propeller or rotating device must be coupled with the failures of paragraphs (d)(4) and (d)(5) of this section.

[(7) Any single propeller or rotating device capable of significant dynamic forces rotating at the highest likely overspeed.

[(8) Any damage or failure condition, required or selected for investigation by § 25.571. The single structural failures described in paragraphs (d)(4) and (d)(5) of this section need not be considered in showing compliance with this section if:

[(i) the structural element could not fail due to discrete source damage resulting from the conditions described in § 25.571(e), and;

[(ii) a damage tolerance investigation in accordance with § 25.571(b) shows that the maximum extent of damage assumed for the purpose of residual strength evaluation does not involve complete failure of the structural element.

for new type designs and for modifications to a type design unless the modifications have been shown to have an insignificant effect on the aeroelastic stability. These tests must demonstrate that the airplane has a proper margin of damping at all speeds up to V_{DF}/M_{DF}, and that there is no large and rapid reduction in damping as V_{DF}/M_{DF} is approached. If a failure, malfunction, or adverse condition is simulated during flight test in showing compliance with paragraph (d) of this section, the maximum speed investigated need not exceed V_{FC}/M_{FC} if it is shown, by correlation of the flight test data with other test data or analyses, that the airplane is free from any aeroelastic instability at all speeds within the altitude-airspeed envelope described in paragraph (b)(2) of this section.]

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–45, Eff. 12/1/78); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–72, Eff. 8/20/90); [(Amdt. 25–77, Eff. 7/29/92)]

§ 25.631 Bird strike damage.

The empennage structure must be designed to assure capability of continued safe flight and landing of the airplane after impact with an 8-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to V_C at sea level, selected under § 25.335(a). Compliance with this section by provision of redundant structure and protected location of control system elements or protective devices such as splitter plates or energy absorbing material is acceptable. Where compliance is shown by analysis, tests, or both, use of data on airplanes having similar structural design is acceptable.

(Amdt. 25–23, Eff. 5/8/70)

CONTROL SURFACES

§ 25.651 Proof of strength.

(a) Limited load tests of control surfaces are required. These tests must include the horn or fitting to which the control system is attached.

(b) Compliance with the special factors requirements of §§ 25.619 through 25.625 and 25.657 for ment.

(b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to the maximum for which the airplane is shown to meet the trim requirements of § 25.161.

§ 25.657 Hinges.

(a) For control surface hinges, including ball, roller, and self-lubricated bearing hinges, the approved rating of the bearing may not be exceeded. For nonstandard bearing hinge configurations, the rating must be established on the basis of experience or tests and, in the absence of a rational investigation, a factor of safety of not less than 6.67 must be used with respect to the ultimate bearing strength of the softest material used as a bearing.

(b) Hinges must have enough strength and rigidity for loads parallel to the hinge line.

(Amdt. 25–23, Eff. 5/8/70)

CONTROL SYSTEMS

§ 25.671 General.

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.

(b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system.

(c) The airplane must be shown by analysis, tests, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot.

(1) Any single failure, excluding jamming (for example, disconnection or failure of mechanical

(3) Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.

(d) The airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.672 Stability augmentation and automatic and power-operated systems.

If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this part, such systems must comply with § 25.671 and the following:

(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring his attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot were not aware of the failure. Warning systems must not activate the control systems.

(b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures of the type specified in § 25.671(c) without requiring exceptional pilot skill or strength, by either the deactivation of the system, or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.

(c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system—

(1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered;

continued safe flight and landing.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.673 [Removed]

§ 25.675 Stops.

(a) Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.

(b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.

(c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

(Amdt. 25–38, Eff. 2/1/77)

§ 25.677 Trim systems.

(a) Trim controls must be designed to prevent inadvertent or abrupt operation and to operate in the plane, and with the sense of motion, of the airplane.

(b) There must be means adjacent to the trim control to indicate the direction of the control movement relative to the airplane motion. In addition, there must be clearly visible means to indicate the position of the trim device with respect to the range of adjustment.

(c) Trim control systems must be designed to prevent creeping in flight. Trim tab controls must be irreversible unless the tab is appropriately balanced and shown to be free from flutter.

(d) If an irreversible tab control system is used, the part from the tab to the attachment of the irreversible unit to the airplane structure must consist of a rigid connection.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.679 Control system gust locks.

(a) There must be a device to prevent damage to the control surfaces (including tabs), and to the control system, from gusts striking the airplane while it is on the ground or water. If the device,

(b) The device must have means to preclude the possibility of it becoming inadvertently engaged in flight.

§ 25.681 Limit load static tests.

(a) Compliance with the limit load requirements of this part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

§ 25.683 Operation tests.

It must be shown by operation tests that when portions of the control system subject to pilot effort loads are loaded to 80 percent of the limit load specified for the system and the powered portions of the control system are loaded to the maximum load expected in normal operation, the system is free from—

(a) Jamming;

(b) Excessive friction; and

(c) Excessive deflection.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.685 Control system details.

(a) Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.

(b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.

(c) There must be means to prevent the slapping of cables or tubes against other parts.

(d) Sections 25.689 and 25.693 apply to cable systems and joints.

(Amdt. 25–38, Eff. 2/1/77)

tension throughout the range of travel under operating conditions and temperature variations.

(b) Each kind and size of pulley must correspond to the cable with which it is used. Pulleys and sprockets must have closely fitted guards to prevent the cables and chains from being displaced or fouled. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange.

(c) Fairleads must be installed so that they do not cause a change in cable direction of more than three degrees.

(d) Clevis pins subject to load or motion and retained only by cotter pins may not be used in the control system.

(e) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.

(f) There must be provisions for visual inspection of fairleads, pulleys, terminals, and turnbuckles.

§ 25.693 Joints.

Control system joints (in push-pull systems) that are subject to angular motion, except those in ball and roller bearing systems, must have a special factor of safety of not less than 3.33 with respect to the ultimate bearing strength of the softest material used as a bearing. This factor may be reduced to 2.0 for joints in cable control systems. For ball or roller bearings, the approved ratings may not be exceeded.

(Amdt. 25–72, Eff. 8/20/90)

§ 25.695 [Revoked]

§ 25.697 Lift and drag devices, controls.

(a) Each lift device control must be designed so that the pilots can place the device in any takeoff, en route, approach, or landing position established under § 25.101(d). Lift and drag devices must maintain the selected positions, except for movement produced by an automatic positioning or load limiting device, without further attention by the pilots.

tics of the automatic positioning or load limiting device must give satisfactory flight and performance characteristics under steady or changing conditions of airspeed, engine power, and airplane altitude.

(d) The lift device control must be designed to retract the surfaces from the fully extended position, during steady flight at maximum continuous engine power at any speed below V_F+9.0 (knots).

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–57, Eff. 3/26/84)

§ 25.699 Lift and drag device indicator.

(a) There must be means to indicate to the pilots the position of each lift or drag device having a separate control in the cockpit to adjust its position. In addition, an indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition, considering the effects on flight characteristics and performance.

(b) There must be means to indicate to the pilots the takeoff, en route, approach, and landing lift device positions.

(c) If any extension of the lift and drag devices beyond the landing position is possible, the control must be clearly marked to identify the range of extension.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.701 Flap and slat interconnection.

(a) Unless the airplane has safe flight characteristics with the flaps or slats retracted on one side and extended on the other, the motion of flaps or slats on opposite sides of the plane of symmetry must be synchronized by a mechanical interconnection or approved equivalent means.

(b) If a wing flap or slat interconnection or equivalent means is used, it must be designed to account for the applicable unsymmetrical loads, including those resulting from flight with the engines on one side of the plane of symmetry inoperative and the remaining engines at takeoff power.

(c) For airplanes with flaps or slats that are not subjected to slipstream conditions, the structure jammed and immovable while the surfaces on the other side are free to move and the full power of the surface actuating system is applied.

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–72, Eff. 8/20/90)

§ 25.703 Takeoff warning system.

A takeoff warning system must be installed and must meet the following requirements:

(a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff roll if the airplane is in a configuration, including any of the following, that would not allow a safe takeoff:

(1) The wing flaps or leading edge devices are not within the approved range of takeoff positions.

(2) Wing spoilers (except lateral control spoilers meeting the requirements of § 25.671), speed brakes, or longitudinal trim devices are in a position that would not allow a safe takeoff.

(b) The warning required by paragraph (a) of this section must continue until—

(1) The configuration is changed to allow a safe takeoff;

(2) Action is taken by the pilot to terminate the takeoff roll;

(3) The airplane is rotated for takeoff; or

(4) The warning is manually deactivated by the pilot.

(c) The means used to activate the system must function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested.

(Amdt. 25–42, Eff. 3/1/78)

LANDING GEAR

§ 25.721 General.

(a) The main landing gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause—

part of the fuel system to constitute a fire hazard.

(b) Each airplane that has a passenger seating configuration excluding pilots seats, of 10 seats or more must be designed so that with the airplane under control it can be landed on a paved runway with any one or more landing gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard.

(c) Compliance with the provisions of this section may be shown by analysis or tests, or both.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–32, Eff. 5/1/72)

§ 25.723 Shock absorption tests.

(a) It must be shown that the limit load factors selected for design in accordance with § 25.473 for takeoff and landing weights, respectively, will not be exceeded. This must be shown by energy absorption tests except that analyses based on earlier tests conducted on the same basic landing gear system which has similar energy absorption characteristics may be used for increases in previously approved takeoff and landing weights.

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. at design landing weight, assuming airplane lift not greater than the airplane weight acting during the landing impact.

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–72, Eff. 8/20/90)

§ 25.725 Limit drop tests.

(a) If compliance with § 25.723(a) is shown by free drop tests, these tests must be made on the complete airplane, or on units consisting of a wheel, tire, and shock absorber, in their proper positions, from free drop heights not less than—

(1) 18.7 inches for the design landing weight conditions; and

(2) 6.7 inches for the design takeoff weight conditions.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used where—

W_e=the effective weight to be used in the drop test (lbs.);

h=specified free drop height (inches);

d=deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches);

$W=W_M$ for main gear units (lbs.), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of nose wheel type airplanes);

$W=W_T$ for tail gate units (lbs.), equal to the static weight on the tail unit with the airplane in the tail-down attitude;

$W= W_N$ for nose wheel units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of $1.0g$ downward and $0.25g$ forward; and

L=the ratio of the assumed airplane lift to the airplane weight, but not more than 1.0

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of a rational or conservative limit load factor value.

(d) The value of d used in the computation of W_e in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

(e) The limit inertia load factor n must be determined from the free drop test in paragraph (b) of this section according to the following formula:

$$n = n_j \frac{W_e}{W} + L$$

where—

n=the load factor developed in the drop test (that is, the acceleration of dv/dt in g's recorded in the drop test) plus 1.0; and

W_e, W, and L are the same as in the drop test computation.

(f) The value of n determined in paragraph (e) of this section may not be more than the limit inertia load factor used in the landing conditions in § 25.473.

(Amdt. 25–23, Eff. 5/8/70)

of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass,

$$W_e = \frac{Wh}{h+d}$$

where the symbols and other details are the same as in § 25.725(b).

(Amdt. 25–23, Eff. 5/8/70)

§ 25.729 Retracting mechanism.

(a) *General.* For airplanes with retractable landing gear, the following apply:

(1) The landing gear retracting mechanism, wheel well doors, and supporting structure, must be designed for—

(i) The loads occurring in the flight conditions when the gear is in the retracted position;

(ii) The combination of friction loads, inertia loads, brake torque loads, air loads, and gyroscopic loads resulting from the wheels rotating at a peripheral speed equal to 1.3 V_S (with the flaps in takeoff position at design takeoff weight), occurring during retraction and extension at any airspeed up to 1.6 V_{S1} (with the flaps in the approach position at design landing weight), and

(iii) Any load factor up to those specified in § 25.345(a) for the flaps extended condition.

(2) Unless there are other means to decelerate the airplane in flight at this speed, the landing gear, the retracting mechanism, and the airplane structure (including wheel well doors) must be designed to withstand the flight loads occurring with the landing gear in the extended position at any speed up to 0.67 V_C.

(3) Landing gear doors, their operating mechanism, and their supporting structures must be designed for the yawing maneuvers prescribed for the airplane in addition to the conditions of airspeed and load factor prescribed in paragraphs (a)(1) and (2) of this section.

(2) The failure of any single source of hydraulic, electric, or equivalent energy supply.

(d) *Operation test.* The proper functioning of the retracting mechanism must be shown by operation tests.

(e) *Position indicator and warning device.* If a retractable landing gear is used, there must be a landing gear position indicator (as well as necessary switches to actuate the indicator) or other means to inform the pilot that the gear is secured in the extended (or retracted) position. This means must be designed as follows:

(1) If switches are used, they must be located and coupled to the landing gear mechanical systems in a manner that prevents an erroneous indication of "down and locked" if the landing gear is not in a fully extended position, or of "up and locked" if the landing gear is not in the fully retracted position. The switches may be located where they are operated by the actual landing gear locking latch or device.

(2) [The flightcrew must be given an aural warning that functions continuously, or is periodically repeated, if a landing is attemped when the landing gear is not locked down.

(3) [The warning must be given in sufficient time to allow the landing gear to be locked down or a go-around to be made.

(4) [There must not be a manual shut-off means readily available to the flightcrew for the warning required by paragraph (e)(2) of this section such that it could be operated instinctively, inadvertently, or by habitual reflexive action.

[(5) The system used to generate the aural warning must be designed to eliminate false or inappropriate alerts.

[(6) Failures of systems used to inhibit the landing gear aural warning, that would prevent the warning system from operating, must be improbable.]

(f) *Protection of equipment in wheel wells.* Equipment that is essential to safe operation of the airplane and that is located in wheel wells must be protected from the damaging effects of—

(1) A bursting tire, unless it is shown that a tire cannot burst from overheat; and

(a) Each main and nose wheel must be approved.

(b) The maximum static load rating of each wheel may not be less than the corresponding static ground reaction with—

(1) Design maximum weight; and

(2) Critical center of gravity.

(c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this part.

(Amdt. 25–72, Eff. 8/20/90)

§ 25.733 Tires.

(a) When a landing gear axle is fitted with a single wheel and tire assembly, the wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions and with a load rating approved by the Administrator that is not exceeded under—

(1) The loads on the main wheel tire, corresponding to the most critical combination of airplane weight (up to the maximum weight) and center of gravity position, and

(2) The loads corresponding to the ground reactions in paragraph (b) of this section, on the nose wheel tire, except as provided in paragraphs (b)(2) and (b)(3) of this section.

(b) The applicable ground reactions for nose wheel tires are as follows:

(1) The static ground reaction for the tire corresponding to the most critical combination of airplane weight (up to maximum ramp weight) and center of gravity position with a force of $1.0g$ acting downward at the center of gravity. This load may not exceed the load rating of the tire.

(2) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to maximum landing weight) and center of gravity position combined with forces of $1.0g$ downward and $0.31g$ forward acting at the center of gravity. The reactions in this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.31 times the vertical load at each wheel

distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.20 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the load rating of the tire.

(c) When a landing gear axle is fitted with more than one wheel and tire assembly, such as dual or dual-tandem, each wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions, and with a load rating approved by the Administrator that is not exceeded by—

(1) The loads on each main wheel tire, corresponding to the most critical combination of airplane weight (up to maximum weight) and center of gravity position, when multiplied by a factor of 1.07; and

(2) Loads specified in paragraphs (a)(2), (b)(1), (b)(2), and (b)(3) of this section on each nose wheel tire.

(d) Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent unintended contact between the tire and any part of the structure or systems.

[(e) For an airplane with a maximum certificated takeoff weight of more [than*] 75,000 pounds, tires mounted on braked wheels must be inflated with dry nitrogen or other gases shown to be inert so that the gas mixture in the tire does not contain oxygen in excess of 5 percent by volume, unless it can be shown that the tire liner material will not produce a volatile gas when heated or that means are provided to prevent tire temperatures from reaching unsafe levels.]

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–38, Eff. 2/1/77); (Amdt. 25–48, Eff. 12/31/79); (Amdt. 25–49, Eff. 12/31/79); (Amdt. 25–72, Eff. 8/20/90); [(Amdt. 25–78, Eff. 3/29/93)]; * = corrected.

§ 25.735 Brakes.

(a) Each brake must be approved.

least 50 percent of that obtained in determining the landing distance as prescribed in that section. Subcomponents within the brake assembly, such as brake drum, shoes, and actuators (or their equivalents), shall be considered as connecting or transmitting elements, unless it is shown that leakages of hydraulic fluid resulting from failure of the sealing elements in these subcomponents within the brake assembly would not reduce the braking effectiveness below that specified in this paragraph.

(c) Brake controls may not require excessive control force in their operation.

(d) The airplane must have a parking control that, when set by the pilot, will without further attention, prevent the airplane from rolling on a paved, level runway with takeoff power on the critical engine.

(e) If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction will result in a hazardous loss of braking ability or directional control of the airplane.

(f) The brake kinetic energy capacity rating of each main wheel-brake assembly may not be less than the kinetic energy absorption requirements determined under either of the following methods:

(1) The brake kinetic energy absorption requirements must be based on a rational analysis of the sequence of events expected during operational landings at maximum landing weight. This analysis must include conservative values of airplane speed at which the brakes are applied, braking coefficient of friction between tires and runway, aerodynamic drag, propeller drag or power-plant forward thrust, and (if more critical) the most adverse single engine or propeller malfunction.

(2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula, which assumes an equal distribution of braking between main wheels:

$KE=0.0443\ WV^2/N$

where—

KE=Kinetic energy per wheel (ft.-lb.);

W=Design landing weight (lb.);

used in the dynamometer tests) may not be more than the V used in the determination of kinetic energy in accordance with paragraph (f) of this section, assuming that the test procedures for wheel-brake assemblies involve a specified rate of deceleration, and, therefore, for the same amount of kinetic energy, the rate of energy absorption (the power absorbing ability of the brake) varies inversely with the initial speed.

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–48, Eff. 12/31/79); (Amdt. 25–72, Eff. 8/20/90)

§ 25.737 Skis.

Each ski must be approved. The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this part.

FLOATS AND HULLS

§ 25.751 Main float buoyancy.

Each main float must have—

(a) A buoyance of 80 percent in excess of that required to support the maximum weight of the seaplane or amphibian in fresh water; and

(b) Not less than five watertight compartments approximately equal in volume.

§ 25.753 Main float design.

Each main float must be approved and must meet the requirements of § 25.521.

§ 25.755 Hulls.

(a) Each hull must have enough watertight compartments so that, with any two adjacent compartments flooded, the buoyancy of the hull and auxiliary floats (and wheel tires, if used) provides a margin of positive stability great enough to minimize the probability of capsizing in rough, fresh water.

(b) Bulkheads with watertight doors may be used for communication between compartments.

unreasonable concentration or fatigue.

(b) The primary controls listed in § 25.779(a), excluding cables and control rods, must be located with respect to the propellers so that no member of the mimimum flight crew (established under § 25.1523), or part of the controls, lies in the region between the plane of rotation of any inboard propeller and the surface generated by a line passing through the center of the propeller hub making an angle of five degrees forward or aft of the plane of rotation of the propeller.

(c) If provision is made for a second pilot, the airplane must be controllable with equal safety from either pilot seat.

(d) The pilot compartment must be constructed so that, when flying in rain or snow, it will not leak in a manner that will distract the crew or harm the structure.

(e) Vibration and noise characteristics of cockpit equipment may not interfere with safe operation of the airplane.

(Amdt. 25–4, Eff. 4/20/65)

§ 25.772 Pilot compartment doors.

Source: Doc. No. 24344 (55 FR 29777, Eff. 7/20/90)

For an airplane that has a maximum passenger seating configuration of more than 20 seats and that has a lockable door installed between the pilot compartment and the passenger compartment:

(a) The emergency exit configuration must be designed so that neither crewmembers nor passengers need use that door in order to reach the emergency exits provided for them; and

(b) Means must be provided to enable flight crewmembers to directly enter the passenger compartment from the pilot compartment if the cockpit door becomes jammed.

(Amdt. 25–33, Eff. 10/21/72); (Amdt. 25–47, Eff. 12/24/79); (Amdt. 25–72, Eff. 8/20/90)

§ 25.773 Pilot compartment view.

(a) *Nonprecipitation conditions.* For nonprecipitation conditions, the following apply:

lished under § 25.1523). This must be shown in day and night flight tests under nonprecipitation conditions.

(b) *Precipitation conditions.* For precipitation conditions, the following apply:

(1) The airplane must have a means to maintain a clear portion of the windshield, during precipitation conditions, sufficient for both pilots to have a sufficiently extensive view along the flight path in normal flight attitudes of the airplane. This means must be designed to function, without continuous attention on the part of the crew, in—

(i) Heavy rain at speeds up to 1.6 V_{S1} with lift and drag devices retracted; and

(ii) The icing conditions specified in § 25.1419 if certification with ice protection provisions is requested.

(2) The first pilot must have—

(i) A window that is openable under the conditions prescribed in paragraph (b)(1) of this section when the cabin is not pressurized, provides the view specified in that paragraph, and gives sufficient protection from the elements against impairment of the pilot's vision; or

(ii) An alternate means to maintain a clear view under the conditions specified in paragraph (b)(1) of this section, considering the probable damage due to a severe hail encounter.

(c) *Internal windshield and window fogging.* The airplane must have a means to prevent fogging of the internal portions of the windshield and window panels over an area which would provide the visibility specified in paragraph (a) of this section under all internal and external ambient conditions, including precipitation conditions, in which the airplane is intended to be operated.

(d) Fixed markers or other guides must be installed at each pilot station to enable the pilots to position themselves in their seats for an optimum combination of outside visibility and instrument scan. If lighted markers or guides are used they

(b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C, at sea level, selected under § 25.335(a).

(c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the airplane must have a means to minimize the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that—

(1) Appears in the front view of the airplane;

(2) Is inclined 15 degrees or more to the longitudinal axis of the airplane; and

(3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.

(d) The design of windshields and windows in pressurized airplanes must be based on factors peculiar to high altitude operation, including the effects of continuous and cyclic pressurization loadings, the inherent characteristics of the material used, and the effects of temperatures and temperature differentials. The windshield and window panels must be capable of withstanding the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects after any single failure in the installation or associated systems. It may be assumed that, after a single failure that is obvious to the flight crew (established under § 25.1523), the cabin pressure differential is reduced from the maximum, in accordance with appropriate operating limitations, to allow continued safe flight of the airplane with a cabin pressure altitude of not more than 15,000 feet.

(e) The windshield panels in front of the pilots must be arranged so that, assuming the loss of vision through any one panel, one or more panels remain available for use by a pilot seated at a and inadvertent operation.

(b) The direction of movement of cockpit controls must meet the requirements of § 25.779. Wherever practicable, the sense of motion involved in the operation of other controls must correspond to the sense of the effect of the operation upon the airplane or upon the part operated. Controls of a variable nature using a rotary motion must move clockwise from the off position, through an increasing range, to the full on position.

(c) The controls must be located and arranged, with respect to the pilots' seats, so that there is full and unrestricted movement of each control without interference from the cockpit structure or the clothing of the minimum flight crew (established under § 25.1523) when any member of this flight crew, from 5′2″ to 6′3″ in height, is seated with the seat belt and shoulder harness (if provided) fastened.

(d) Identical powerplant controls for each engine must be located to prevent confusion as to the engines they control.

(e) Wing flap controls and other auxiliary lift device controls must be located on top of the pedestal, aft of the throttles, centrally or to the right of the pedestal centerline, and not less than 10 inches aft of the landing gear control.

(f) The landing gear control must be located forward of the throttles and must be operable by each pilot when seated with seat belt and shoulder harness (if provided) fastened.

(g) Control knobs must be shaped in accordance with § 25.781. In addition, the knobs must be of the same color, and this color must contrast with the color of control knobs for other purposes and the surrounding cockpit.

(h) If a flight engineer is required as part of the minimum flight crew (established under § 25.1523), the airplane must have a flight engineer station located and arranged so that the flight crew-

(a) Aerodynamic controls:

(1) *Primary.*

Controls	*Motion and effect*
Aileron	Right (clockwise) for right wing down.
Elevator	Rearward for nose up.
Rudder	Right pedal forward for nose right.

(2) *Secondary.*

Controls	*Motion and effect*
Flaps (or auxiliary lift devices).	Forward for flaps up; rearward for flaps down.
Trim tabs (or equivalent).	Rotate to produce similar rotation of the airplane about an axis parallel to the axis of the control.

(b) Powerplant and auxiliary controls:

(1) *Powerplant.*

Controls	*Motion and effect*
Power or thrust	Forward to increase forward thrust and rearward to increase rearward thrust.
Propellers	Forward to increase rpm.
Mixture	Forward or upward for rich.
Carburetor air heat.	Forward or upward for cold.
Supercharger	Forward or upward for low blower. For turbosuperchargers, forward, upward, or clockwise, to increase pressure.

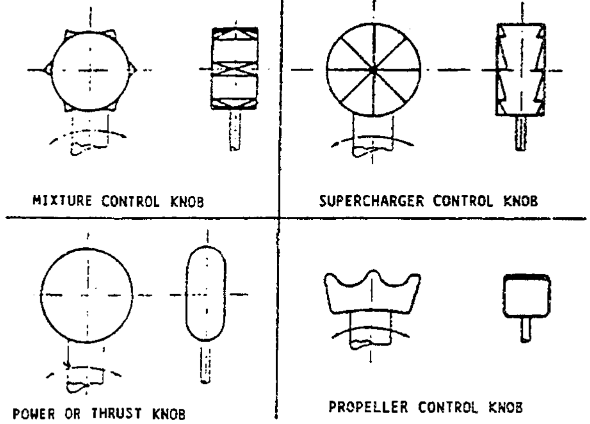
(2) *Auxiliary.*

Controls	*Motion and effect*
Landing gear	Down to extend.

(Amdt. 25–72, Eff. 8/20/90)

§ 25.781 Cockpit control knob shape.

Cockpit control knob must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure:



(Amdt. 25–72, Eff. 8/20/90)

§ 25.783 Doors.

(a) Each cabin must have at least one easily accessible external door.

(b) There must be a means to lock and safeguard each external door againstopening in flight (either inadvertently by persons or as a result of mechanical failure or failure of a single structural element either during or after closure). Each external door must be openable from both the inside and the outside, even though persons may be crowded against the door on the inside of the airplane. Inward opening doors may be used if there are means to prevent occupants from crowding against the door to an extent that would interfere with the opening of the door. The means of opening must be simple and obvious and must be arranged and marked so that it can be readily located and operated, even in darkness. Auxiliary locking devices may be used.

(c) Each external door must be reasonably free from jamming as a result of fuselage deformation in a minor crash.

(d) Each external door must be located where persons using them will not be endangered by the propellers when appropriate operating procedures are used.

(e) There must be a provision for direct visual inspection of the locking mechanism to determine if external doors, for which the initial opening movement is not inward (including passenger, crew, service, and cargo doors), are fully closed and locked. The provision must be discernible under operational lighting conditions by appropriate crewmembers using a flashlight or equivalent lighting source. In addition, there must be a visual warning means to signal the appropriate flight crewmembers if any external door is not fully closed and locked. The means must be designed such that any failure or combination of failures that would result in an erroneous closed and locked indication is improbable for doors for which the initial opening movement is not inward.

(f) External doors must have provisions to prevent the initiation of pressurization of the airplane to an unsafe level if the door is not fully closed and locked. In addition, it must be shown by safety analysis that inadvertent opening is extremely improbable.

(g) Cargo and service doors not suitable for use as emergency exits only meet paragraphs (e) and (f) of this section and be safeguarded against opening in flight as a result of mechanical failure or failure of a single structural element.

(h) Each passenger entry door in the side of the fuselage must qualify as a Type A, Type I, or Type II passenger emergency exit and must meet forces specified in § 25.561(b)(3), acting separately relative to the surrounding structure.

(2) The airplane is in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear.

(j) All lavatory doors must be designed to preclude anyone from becoming trapped inside the lavatory, and if a locking mechanism is installed, it be capable of being unlocked from the outside without the aid of special tools.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–54, Eff. 10/14/80); (Amdt. 25–72, Eff. 8/20/90)

§ 25.785 Seats, berths, safety belts, and harnesses.

(a) A seat (or berth for a nonambulant person) must be provided for each occupant who has reached his or her second birthday.

(b) Each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in §§ 25.561 and 25.562.

(c) Each seat or berth must be approved.

(d) Each occupant of a seat that makes more than an 18° angle with the vertical plane containing the airplane centerline must be protected from head injury by a safety belt and an energy absorbing rest that will support the arms, shoulders, head, and spine, or by a safety belt and shoulder harness that will prevent the head from contacting any injurious object. Each occupant of any other seat must be protected from head injury by a safety belt and, as appropriate to the type, location, and angle of facing of each seat, by one or more of the following:

(1) A shoulder harness that will prevent the head from contacting any injurious object.

(2) The elimination of any injurious object within striking radius of the head.

occupying the berth during emergency conditions.

(f) Each seat or berth, and its supporting structure, and each safety belt or harness and its anchorage must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions among the occupant, seat, safety belt, and harness for each relevant flight and ground load condition (including the emergency landing conditions prescribed in § 25.561). In addition—

(1) The structural analysis and testing of the seats, berths, and their supporting structures may be determined by assuming that the critical load in the forward, sideward, downward, upward, and rearward directions (as determined from the prescribed flight, ground, and emergency landing conditions) acts separately or using selected combinations of loads if the required strength in each specified direction is substantiated. The forward load factor need not be applied to safety belts for berths.

(2) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in § 25.395.

(3) The inertia forces specified in § 25.561 must be multiplied by a factor of 1.33 (instead of the fitting factor prescribed in § 25.625) in determining the strength of the attachment of each seat to the structure and each belt or harness to the seat or structure.

(g) Each seat at a flight deck station must have a restraint system consisting of a combined safety belt and shoulder harness with a single-point release that permits the flight deck occupant, when seated with the restraint system fastened, to perform all of the occupant's necessary flight deck functions. There must be a means to secure each combined restraint system when not in use to prevent interference with the operation of the airplane and with rapid egress in an emergency.

(h) Each seat located in the passenger compartment and designated for use during takeoff and landing by a flight attendant required by the operating rules of this chapter must be:

(1) Near a required floor level emergency exit, except that another location is acceptable if the

area for which the flight attendant is responsible.

(3) Positioned so that the seat will not interfere with the use of a passageway or exit when the seat is not in use.

(4) Located to minimize the probability that occupants would suffer injury by being struck by items dislodged from service areas, stowage compartments, or service equipment.

(5) Either forward or rearward facing with an energy absorbing rest that is designed to support the arms, shoulders, head, and spine.

(6) Equipped with a restraint system consisting of a combined safety belt and shoulder harness unit with a single point release. There must be means to secure each restraint system when not in use to prevent interference with rapid egress in an emergency.

(i) Each safety belt must be equipped with a metal to metal latching device.

(j) If the seat backs do not provide a firm handhold, there must be a handgrip or rail along each aisle to enable persons to steady themselves while using the aisles in moderately rough air.

(k) Each projecting object that would injure persons seated or moving about the airplane in normal flight must be padded.

(l) Each forward observer's seat required by the operating rules must be shown to be suitable for use in conducting the necessary enroute inspection.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–20, Eff. 4/23/69); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–51, Eff. 3/6/80); (Amdt. 25–64, Eff. 6/16/88); (Amdt. 25–72, Eff. 8/20/90)

§ 25.787 Stowage compartments.

(a) Each compartment for the stowage of cargo, baggage, carry-on articles, and equipment (such as life rafts), and any other stowage compartment must be designed for its placarded maximum weight of contents and for the critical load distribution at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of § 25.561(b), except that the forces specified in the

tents in the compartments from becoming a hazard by shifting, under the loads specified in paragraph (a) of this section. For stowage compartments in the passenger and crew cabin, if the means used is a latched door, the design must take into consideration the wear and deterioration expected in service.

(c) if cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.

(Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–38, Eff. 2/1/77); (Amdt. 25–51, Eff. 3/6/80)

§ 25.789 Retention of items of mass in passenger and crew compartments and galleys.

(a) Means must be provided to prevent each item of mass (that is part of the airplane type design) in a passenger or crew compartment or galley from becoming a hazard by shifting under the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of § 25.561(b).

(b) Each interphone restraint system must be designed so that when subjected to the load factors specified in § 25.561(b)(3), the interphone will remain in its stowed position.

(Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–46, Eff. 12/1/78)

§ 25.791 Passenger information signs and placards.

(a) If smoking is to be prohibited, there must be at least one placard so stating that is legible to each person seated in the cabin. If smoking is to be allowed, and if the crew compartment is separated from the passenger compartment, there must be at least one sign notifying when smoking is prohibited. Signs which notify when smoking is prohibited must be operable by a member of the flightcrew and, when illuminated, must be legible under all probable conditions of cabin illumination to each person seated in the cabin.

of flammable waste materials to indicate that use of the receptacle for disposal of cigarettes, etc., is prohibited.

(d) Lavatories must have ''No Smoking'' or ''No Smoking in Lavatory'' placards conspicuously located on or adjacent to each side of the entry door.

(e) Symbols that clearly express the intent of the sign or placard may be used in lieu of letters.

(Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–72, Eff. 8/20/90)

§ 25.793 Floor surfaces.

The floor surface of all areas which are likely to become wet in service must have slip resistant properties.

(Amdt. 25–51, Eff. 3/6/80)

EMERGENCY PROVISIONS

§ 25.801 Ditching.

(a) If certification with ditching provisions is requested, the airplane must meet the requirements of this section and §§ 25.807(e), 25.1411, and 25.1415(a).

(b) Each practicable design measure, compatible with the general characteristics of the airplane, must be taken to minimize the probability that in an emergency landing on water, the behavior of the airplane would cause immediate injury to the occupants or would make it impossible for them to escape.

(c) The probable behavior of the airplane in a water landing must be investigated by model tests or by comparison with airplanes of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the airplane, must be considered.

(d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the airplane will allow the occupants to leave the airplane and enter the life-rafts required by § 25.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the airplane has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.

(e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the airplane in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.

(Amdt. 25–72, Eff. 8/20/90)

§ 25.803 Emergency evacuation.

Source: Doc. No. 24344 (55 FR 29781, Eff. 7/20/90)

(a) Each crew and passenger area must have emergency means to allow rapid evacuation in crash landings, with the landing gear extended as well as with the landing gear retracted, considering the possibility of the airplane being on fire.

(b) Reserved

(c) For airplanes having a seating capacity of more than 44 passengers, it must be shown that the maximum seating capacity, including the number of crewmembers required by the operating rules for which certification is requested, can be evacuated from the airplane to the ground under simulated emergency conditions within 90 seconds. Compliance with this requirement must be shown by actual demonstration using the test criteria outlined in appendix J of this part unless the Administrator finds that a combination of analysis and testing will provide data equivalent to that which would be obtained by actual demonstration.

(d) Reserved

(e) Reserved

(Amdt. 25–1, Eff. 6/7/65); (Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–17, Eff. 6/20/68); (Amdt. 25–20, Eff. 4/23/69); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–72, Eff. 8/20/90)

§ 25.805 Removed

§ 25.807 Emergency exits.

(a) *Type*. For the purpose of this part, the types of exits are defined as follows:

(1) *Type I*. This type is a floor level exit with a rectangular opening of not less than 24

down outside the airplane of more than 17 inches.

(3) *Type III.* This type is a rectangular opening of not less than 20 inches wide by 36 inches high, with corner radii not greater than one-third the width of the exit, and with a step-up inside the airplane of not more than 20 inches. If the exit is located over the wing, the step-down outside the airplane may not exceed 27 inches.

(4) *Type IV.* This type is a rectangular opening of not less than 19 inches wide by 26 inches high, with corner radii not greater than one-third the width of the exit, located over the wing, with a step-up inside the airplane of not more than 29 inches and a step-down outside the airplane of not more than 36 inches.

(5) *Ventral.* This type is an exit from the passenger compartment through the pressure shell and the bottom fuselage skin. The dimensions and physical configuration of this type of exit must allow at least the same rate of egress as a Type I exit with the airplane in the normal ground attitude, with landing gear extended.

(6) *Tail cone.* This type is an aft exit from the passenger compartment through the pressure shell and through an openable cone of the fuselage aft of the pressure shell. The means of opening the tailcone must be simple and obvious and must employ a single operation.

(7) *Type A.* This type is a floor level exit with a rectangular opening of not less than 42 inches wide by 72 inches high with corner radii not greater than one-sixth of the width of the exit.

(b) *Step down distance.* Step down distance, as used in this section, means the actual distance between the bottom of the required opening and a usable foot hold, extending out from the fuselage, that is large enough to be effective without searching by sight or feel.

(c) *Over-sized exits.* Openings larger than those specified in this section, whether or not of rectangular shape, may be used if the specified rectangular opening can be inscribed within the opening and the base of the inscribed rectangular opening meets the specified step-up and step-down heights.

(crewmember seats not included)	Type I	Type II	Type III	Type IV
1 through 9	....	....	....	1
10 through 19	....	....	1	
20 through 39	....	1	1	
40 through 79	1	....	1	
80 through 109	1	....	2	
110 through 139	2	....	1	
140 through 179	2	....	2	

Additional exits are required for passenger seating configurations greater than 179 seats in accordance with the following table:

Additional emergency exits (each side of fuselage)	*Increase in passenger seating configuration allowed*
Type A	110
Type I	45
Type II	40
Type III	35

(2) For passenger seating configurations greater than 299 seats, each emergency exit in the side of the fuselage must be either a Type A or Type I. A passenger seating configuration of 110 seats is allowed for each pair of Type A exits and a passenger seating configuration of 45 seats is allowed for each pair of Type I exits.

(3) If a passenger ventral or tail cone exit is installed and that exit provides at least the same rate of egress as a Type III exit with the airplane in the most adverse exit opening condition that would result from the collapse of one or more legs of the landing gear, an increase in the passenger seating configuration beyond the limits specified in paragraph (d)(1) or (2) of this section may be allowed as follows:

(i) For a ventral exit, 12 additional passenger seats.

(ii) For a tail cone exit incorporating a floor level opening of not less than 20 inches wide by 60 inches high, with corner radii not greater than one-third the width of the exit, in the pressure shell and incorporating an approved assist means in accordance with § 25.809(h), 25 additional passenger seats.

(4) For airplanes on which the vertical location of the wing does not allow the installation of overwing exits, an exit of at least the dimensions of a Type III exit must be installed instead of each Type IV exit required by subparagraph (1) of this paragraph.

(5) An alternate emergency exit configuration may be approved in lieu of that specified in paragraph (d)(1) or (2) of this section provided the overall evacuation capability is shown to be equal to or greater than that of the specified emergency exit configuration.

(6) The following must also meet the applicable emergency exit requirements of §§25.809 through 25.813:

(i) Each emergency exit in the passenger compartment in excess of the minimum number of required emergency exits.

(ii) Any other floor level door or exit that is accessible from the passenger compartment and is as large or larger than a Type II exit, but less than 46 inches wide.

(iii) Any other passenger ventral or tail cone exit.

(7) For an airplane that is required to have more than one passenger emergency exit for each side of the fuselage, no passenger emergency exit shall be more than 60 feet from any adjacent passenger emergency exit on the same side of the same deck of the fuselage, as measured parallel to the airplane's longitudinal axis between the nearest exit edges.

(e) *Ditching emergency exits for passengers.* Ditching emergency exits must be provided in accordance with the following requirements whether or not certification with ditching provisions is requested:

(1) For airplanes that have a passenger seating configuration of nine seats or less, excluding pilots seats, one exit above the waterline in each side of the airplane, meeting at least the dimensions of a Type IV exit.

(2) For airplanes that have a passenger seating configuration of 10 seats or more, excluding pilots seats, one exit above the waterline in a side of the airplane, meeting at least the dimen-

(3) If side exits cannot be above the waterline, the side exits must be replaced by an equal number of readily accessible overhead hatches of not less than the dimensions of a Type III exit, except that for airplanes which a passenger configuration of 35 seats or less, excluding pilots seats, the two required Type III side exits need be replaced by only one overhead hatch.

(f) *Flightcrew emergency exits.* For airplanes in which the proximity of passenger emergency exits to the flightcrew area does not offer a convenient and readily accessible means of evacuation of the flightcrew, and for all airplanes having a passenger seating capacity greater than 20, flightcrew exits shall be located in the flightcrew area. Such exits shall be of sufficient size and so located as to permit rapid evacuation by the crew. One exit shall be provided on each side of the airplane; or, alternatively, a top hatch shall be provided. Each exit must encompass an unobstructed rectangular opening of at least 19 by 20 inches unless satisfactory exit utility can be demonstrated by a typical crewmember.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–39, Eff. 2/10/77); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–55, Eff. 4/28/82); (Amdt. 25–67, Eff. 7/24/89); (Amdt. 25–72, Eff. 8/20/90)

§25.809 Emergency exit arrangement.

(a) Each emergency exit, including a flight crew emergency exit, must be a movable door or hatch in the external walls of the fuselage, allowing unobstructed opening to the outside.

(b) Each emergency exit must be openable from the inside and the outside except that sliding window emergency exits in the flight crew area need not be openable from the outside if other approved exits are convenient and readily accessible to the flight crew area. Each emergency exit must be capable of being opened, when there is no fuselage deformation—

(1) With the airplane in the normal ground attitude and in each of the attitudes corresponding

sequence operations (such as operation of two handles or latches or the release of safety catches) may be used for flight crew emergency exits if it can be reasonably established that these means are simple and obvious to crewmembers trained in their use.

(d) If a single power-boost or single power-operated system is the primary system for operating more than one exit in an emergency, each exit must be capable of meeting the requirements of paragraph (b) of this section in the event of failure of the primary system. Manual operation of the exit (after failure of the primary system) is acceptable.

(e) Each emergency exit must be shown by tests, or by a combination of analysis and tests, to meet the requirements of paragraphs (b) and (c) of this section.

(f) There must be a means to lock each emergency exit and to safeguard against its opening in flight, either inadvertently by persons or as a result of mechanical failure. In addition, there must be a means for direct visual inspection of the locking mechanism by crewmembers to determine that each emergency exit, for which the initial opening movement is outward, is fully locked.

(g) There must be provisions to minimize the probability of jamming of the emergency exits resulting from fuselage deformation in a minor crash landing.

(h) When required by the operating rules for any large passenger-carrying turbojet-powered airplane, each ventral exit and tail-cone exit must be—

(1) Designed and constructed so that it cannot be opened during flight; and

(2) Marked with a placard readable from a distance of 30 inches and installed at a conspicuous location near the means of opening the exit, stating that the exit has been designed and constructed so that it cannot be opened during flight.

(Amdt. 25–1, Eff. 6/7/65); (Amdt. 25–9, Eff. 6/30/66); (Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–34, Eff. 12/31/72); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–47, Eff. 12/24/79); (Amdt. 25–72, Eff. 8/20/90)

(1) The assisting means for each passenger emergency exit must be a self supporting slide or equivalent; and, in the case of a Type A exit, it must be capable of carrying simultaneously two parallel lines of evacuees. In addition, the assisting means must be designed to meet the following requirements:

(i) It must be automatically deployed and deployment must begin during the interval between the time the exit opening means is actuated from inside the airplane and the time the exit is fully opened. However, each passenger emergency exit which is also a passenger entrance door or a service door must be provided with means to prevent deployment of the assisting means when it is opened from either the inside or the outside under non-emergency conditions for normal use.

(ii) It must be automatically erected within 10 seconds after deployment is begun.

(iii) It must be of such length after full deployment that the lower end is self-supporting on the ground and provides safe evacuation of occupants to the ground after collapse of one or more legs of the landing gear.

(iv) It must have the capability, in 25-knot winds directed from the most critical angle, to deploy and, with the assistance of only one person, to remain usable after full deployment to evacuate occupants safely to the ground.

(v) For each system installation (mockup or airplane installed), five consecutive deployment and inflation tests must be conducted (per exit) without failure, and at least three tests of each such five-test series must be conducted using a single representative sample of the device. The sample devices must be deployed and inflated by the system's primary means after being subjected to the inertia forces specified in § 25.561(b). If any part of the system fails or does not function properly during the required tests, the cause of the failure or malfunction must be corrected by positive means and after that, the full series of five consecutive deployment and inflation tests must be conducted without failure.

stowed device, or its attachment, would reduce the pilot's view in flight;

(ii) Able (with its attachment) to withstand a 400-pound static load.

(b) Assist means from the cabin to the wing are required for each Type A exit located above the wing and having a stepdown unless the exit without an assist means can be shown to have a rate of passenger egress at least equal to that of the same type of nonoverwing exit. If an assist means is required, it must be automatically deployed and automatically erected, concurrent with the opening of the exit and self-supporting within 10 seconds.

(c) An escape route must be established from each overwing emergency exit, and (except for flap surfaces suitable as slides) covered with a slip resistant surface. Except where a means for channeling the flow of evacuees is provided—

(1) The escape route must be at least 42 inches wide at Type A passenger emergency exits and must be at least 2 feet wide at all other passenger emergency exits, and

(2) The escape route surface must have a reflectance of at least 80 percent, and must be defined by markings with a surface-to-marking contrast ratio of at least 5:1.

(d) If the place on the airplane structure at which the escape route required in paragraph (c) of this section terminates, is more than 6 feet from the ground with the airplane on the ground and the landing gear extended, means to reach the ground must be provided to assist evacuees who have used the escape route. If the escape route is over a flap, the height of the terminal edge must be measured with the flap in the takeoff or landing position, whichever is higher from the ground. The assisting means must be usable and self-supporting with one or more landing gear legs collapsed and under a 25-knot wind directed from the most critical angle. The assisting means provided for each escape route leading from a Type A emergency exit must be capable of carrying simultaneously two parallel lines of evacuees. For other than Type A exits, the assist means must be capable of carrying

(b) The identity and location of each passenger emergency exit must be recognizable from a distance equal to the width of the cabin.

(c) Means must be provided to assist the occupants in locating the exits in conditions of dense smoke.

(d) The location of each passenger emergency exit must be indicated by a sign visible to occupants approaching along the main passenger aisle (or aisles). There must be—

(1) A passenger emergency exit locator sign above the aisle (or aisles) near each passenger emergency exit, or at another overhead location if it is more practical because of low headroom, except that one sign may serve more than one exit if each exit can be seen readily from the sign;

(2) A passenger emergency exit marking sign next to each passenger emergency exit, except that one sign may serve two such exits if they both can be seen readily from the sign; and

(3) A sign on each bulkhead or divider that prevents fore and aft vision along the passenger cabin to indicate emergency exits beyond and obscured by the bulkhead or divider, except that if this is not possible the sign may be placed at another appropriate location.

(e) The location of the operating handle and instructions for opening exits from the inside of the airplane must be shown in the following manner:

(1) Each passenger emergency exit must have, on or near the exit, a marking that is readable from a distance of 30 inches.

(2) [Each passenger emergency exit operating handle and the cover removal instructions, if the operating handle is covered, must—]

(i) Be self-illuminated with an initial brightness of at least 160 microlamberts; or

(ii) Be conspicuously located and well illuminated by the emergency lighting even in conditions of occupant crowding at the exit.

(3) [Reserved]

(4) Each Type A, Type I, and Type II passenger emergency exit with a locking mechanism

is within ±1 inch of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism, and

(iii) With the word ''open'' in red letters 1 inch high, placed horizontally near the head of the arrow.

(f) Each emergency exit that is required to be openable from the outside, and its means of opening, must be marked on the outside of the airplane. In addition, the following apply:

(1) The outside marking for each passenger emergency exit in the side of the fuselage must include a 2-inch colored band outlining the exit.

(2) Each outside marking including the band, must have color contrast to be readily distinguishable from the surrounding fuselage surface. The contrast must be such that if the reflectance of the darker color is 15 percent or less, the reflectance of the lighter color must be at least 45 percent. ''Reflectance'' is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker color is greater than 15 percent, at least a 30-percent difference between its reflectance and the reflectance of the lighter color must be provided.

(3) In the case of exits other than those in the side of the fuselage, such as ventral or tail cone exits, the external means of opening, including instructions if applicable, must be conspicuously marked in red, or bright chrome yellow if the background color is such that red is inconspicuous. When the opening means is located on only one side of the fuselage, a conspicuous marking to that effect must be provided on the other side.

(g) Each sign required by paragraph (d) of this section may use the word ''exit'' in its legend in place of the term ''emergency exit''.

(Amdt. 25–1, Eff. 6/7/65); (Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–46, Eff. 12/1/78); [(Amdt. 25–79, Eff. 9/27/93)]

lighting system must include:

(1) Illuminated emergency exit marking and locating signs, sources of general cabin illumination, interior lighting in emergency exit areas, and floor proximity escape path marking.

(2) Exterior emergency lighting.

(b) Emergency exit signs—

(1) For airplanes that have a passenger seating configuration, excluding pilot seats, of 10 seats or more must meet the following requirements:

(i) Each passenger emergency exit locator sign required by § 25.811(d)(1) and each passenger emergency exit marking sign required by § 25.811(d)(2) must have red letters at least 1½ inches high on an illuminated white background, and must have an area of at least 21 square inches excluding the letters. The lighted background-to-letter contrast must be at least 10:1. The letter height to stroke-width ratio may not be more than 7:1 nor less than 6:1. These signs must be internally electrically illuminated with a background brightness of at least 25 foot-lamberts and a high-to-low background contrast no greater than 3:1.

(ii) Each passenger emergency exit sign required by § 25.811(d)(3) must have red letters at least 1½ inches high on a white background having an area of at least 21 square inches excluding the letters. These signs must be internally electrically illuminated or self-illuminated by other than electrical means and must have an initial brightness of at least 400 microlamberts. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.

(2) For airplanes that have a passenger seating configuration, excluding pilot seats, of nine seats or less, that are required by § 25.811(d)(1), (2), and (3) must have red letters at least 1 inch high on a white background at least 2 inches high. These signs may be internally electrically illuminated, or self-illuminated by other than electrical means, with an initial brightness of at least 160 microlamberts The colors may be

candle. A main passenger aisle(s) is considered to extend along the fuselage from the most forward passenger emergency exit or cabin occupant seat, whichever is farther forward, to the most rearward passenger emergency exit or cabin occupant seat, whichever is farther aft.

(d) The floor of the passageway leading to each floor-level passenger emergency exit, between the main aisles and the exit openings, must be provided with illumination that is not less than 0.02 foot-candle measured along a line that is within six inches of and parallel to the floor and is centered on the passenger evacuation path.

(e) Floor proximity emergency escape path marking must provide emergency evacuation guidance for passengers when all sources of illumination more than 4 feet above the cabin aisle floor are totally obscured. In the dark of the night, the floor proximity emergency escape path marking must enable each passenger to—

(1) After leaving the passenger seat, visually identify the emergency escape path along the cabin aisle floor to the first exits or pair of exits forward and aft of the seat; and

(2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor.

(f) Except for subsystems provided in accordance with paragraph (h) of this section that serve no more than one assist means, are independent of the airplane's main emergency lighting system, and are automatically activated when the assist means is erected, the emergency lighting system must be designed as follows:

(1) The lights must be operable manually from the flight crew station and from a point in the passenger compartment that is readily accessable to a normal flight attendant seat.

(2) There must be a flight crew warning light which illuminates when power is on in the airplane and the emergency lighting control device is not armed.

(3) The cockpit control device must have an "on," "off," and "armed" position so that when armed in the cockpit or turned on at either

as follows:

(1) At each overwing emergency exit the illumination must be—

(i) Not less than 0.03 foot-candle (measured normal to the direction of the incident light) on a two-square-foot area where an evacuee is likely to make his first step outside the cabin;

(ii) Not less than 0.05 foot-candle (measured normal to the direction of the incident light) for a minimum width of 42 inches for a Type A overwing emergency exit and of 2 feet for all other overwing emergency exits along the 30 percent of the slip-resistant portion of the escape route required in § 25.803(e) that is farthest from the exit; and

(iii) Not less than 0.03 foot-candle on the ground surface with the landing gear extended (measured normal to the direction of the incident light) where an evacuee using the established escape route would normally make first contact with the ground.

(2) At each non-overwing emergency exit not required by § 25.809(f) to have descent assist means the illumination must be not less than 0.03 foot-candle (measured normal to the direction of the incident light) on the ground surface with the landing gear extended where an evacuee is likely to make his first contact with the ground outside the cabin.

(h) The means required in § 25.809(f)(1) and (h) to assist the occupants in descending to the ground must be illuminated so that the erected assist means is visible from the airplane.

(1) If the assist means is illuminated by exterior emergency lighting, it must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee using the established escape route would normally make first contact with the ground, with the airplane in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.

(2) If the emergency lighting subsystem illuminating the assist means serves no other

of the erected assist means where an evacuee would normally make first contact with the ground, with the airplane in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.

(i) The energy supply to each emergency lighting unit must provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing.

(j) If storage batteries are used as the energy supply for the emergency lighting system, they may be recharged from the airplane's main electric power system: *Provided,* That, the charging circuit is designed to preclude inadvertent battery discharge into charging circuit faults.

(k) Components of the emergency lighting system, including batteries, wiring relays, lamps, and switches must be capable of normal operation after having been subjected to the inertia forces listed in § 25.561(b).

(l) The emergency lighting system must be designed so that after any single transverse vertical separation of the fuselage during crash landing—

(1) Not more than 25 percent of all electrically illuminated emergency lights required by this section are rendered inoperative, in addition to the lights that are directly damaged by the separation;

(2) Each electrically illuminated exit sign required under § 25.811(d)(2) remains operative exclusive of those that are directly damaged by the separation; and

(3) At least one required exterior emergency light for each side of the airplane remains operative exclusive of those that are directly damaged by the separation.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–28, Eff. 9/25/71); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–58, Eff. 11/26/84)

§ 25.813 Emergency exit access.

Each required emergency exit must be accessible to the passengers and located where it will afford an effective means of evacuation. Emergency exit distribution must be as uniform as practical, taking passenger distribution into account; however, the exit per side must be located near each end of the cabin, except that this provision does not apply to combination cargo/passenger configurations. In addition—

(a) [There must be a passageway leading from the nearest main aisle to each Type I, Type II, or Type A emergency exit and between individual passenger areas. Each passageway leading to a Type A exit must be unobstructed and at least 36 inches wide. Passageways between individual passenger areas and those leading to Type I or Type II emergency exits must be unobstructed and at least 20 inches wide. Unless there are two or more main aisles, each Type A exit must be located so that there is passenger flow along the main aisle to that exit from both the forward and aft directions. If two or more main aisles are provided, there must be unobstructed cross-aisles at least 20 inches wide between main aisles. There must be—

[(1) A cross-aisle which leads directly to each passageway between the nearest main aisle and a Type A exit; and

[(2) A cross-aisle which leads to the immediate vicinity of each passageway between the nearest main aisle and a Type I, Type II, or Type III exit; except that when two Type III exits are located within three passenger rows of each other, a single cross-aisle may be used if it leads to the vicinity between the passageways from the nearest main aisle to each exit.]

(b) Adequate space to allow crewmember(s) to assist in the evacuation of passengers must be provided as follows:

(1) The assist space must not reduce the unobstructed width of the passageway below that required for the exit.

(2) For each Type A exit, assist space must be provided at each side of the exit regardless of whether the exit is covered by § 25.810(a).

(3) For any other type exit that is covered by § 25.810(a), space must at least be provided at one side of the passageway.

(c) [The following must be provided for each Type III or Type IV exit—

(1) [There must be access from the nearest aisle to each exit. In addition, for each Type

in which those rows contain three seats. The width of the passageway must be measured with adjacent seats adjusted to their most adverse position. The centerline of the required passageway width must not be displaced more than 5 inches horizontally from that of the exit.

[(ii) In lieu of one 10- or 20-inch passageway, there may be two passageways, between seat rows only, that must be at least 6 inches in width and lead to an unobstructed space adjacent to each exit. (Adjacent exits must not share a common passageway.) The width of the passageways must be measured with adjacent seats adjusted to their most adverse position. The unobstructed space adjacent to the exit must extend vertically from the floor to the ceiling (or bottom of sidewall stowage bins), inboard from the exit for a distance not less than the width of the narrowest passenger seat installed on the airplane, and from the forward edge of the forward passageway to the aft edge of the aft passageway. The exit opening must be totally within the fore and aft bounds of the unobstructed space.

(2) [In addition to the access—

[(i) For airplanes that have a passenger seating configuration of 20 or more, the projected opening of the exit provided must not be obstructed and there must be no interference in opening the exit by seats, berths, or other protrusions (including any seatback in the most adverse position) for a distance from that exit not less than the width of the narrowest passenger seat installed on the airplane.

[(ii) For airplanes that have a passenger seating configuration of 19 or fewer, there may be minor obstructions in this region, if there are compensating factors to maintain the effectiveness of the exit.

[(3) For each Type III exit, regardless of the passenger capacity of the airplane in which it is installed, there must be placards that—

[(i) Are readible by all persons seated adjacent to and facing a passageway to the exit;

required emergency exit from any seat in the passenger cabin, the passageway must be unobstructed. However, curtains may be used if they allow free entry through the passageway.

(e) No door may be installed in any partition between passenger compartments.

(f) If it is necessary to pass through a doorway separating the passenger cabin from other areas to reach any required emergency exit from any passenger seat, the door must have a means to latch it in open position. The latching means must be able to withstand the loads imposed upon it when the door is subjected to the ultimate inertia forces, relative to the surrounding structure, listed in § 25.561(b).

(Amdt. 25–1, Eff. 6/7/65); (Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–17, Eff. 6/20/68); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–46, Eff. 12/1/78); (Amdt. 25–72, Eff. 8/20/90); [(Amdt. 25–76, Eff. 6/3/92)]

§ 25.815 Width of aisle.

The passenger aisle width at any point between seats must equal or exceed the values in the following table:

Passenger seating capacity	Minimum passenger aisle width (inches)	
	Less than 25 inches from floor	25 inches and more from floor
10 or less	*12	15
11 through 19	12	20
20 or more	15	20

*A narrower width not less than 9 inches may be approved when substantiated by tests found necessary by the Administrator.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–38, Eff. 2/1/77)

(including galleys.)

For airplanes with a service compartment located below the main deck, which may be occupied during taxi or flight but not during takeoff or landing, the following apply:

(a) There must be at least two emergency evacuation routes, one at each end of each lower deck service compartment or two having sufficient separation within each compartment, which could be used by each occupant or the lower deck service compartment to rapidly evacuate to the main deck under normal and emergency lighting conditions. The routes must provide for the evacuation of incapacitated persons, with assistance. The use of the evacuation routes may not be dependent on any powered device. The routes must be designed to minimize the possibility of blockage which might result from fire, mechanical or structural failure, or persons standing on top of or against the escape routes. In the event the airplane's main power system or compartment main lighting system should fail, emergency illumination for each lower deck service compartment must be automatically provided.

(b) There must be a means for two-way voice communication between the flight deck and each lower deck service compartment.

(c) There must be an aural emergency alarm system, audible during normal and emergency conditions, to enable crewmembers on the flight deck and at each required floor level emergency exit to alert occupants of each lower deck service compartment of an emergency situation.

(d) There must be a means, readily detectable by occupants of each lower deck service compartment, that indicates when seat belts should be fastened.

(e) If a public address system is installed in the airplane, speakers must be provided in each lower deck service compartment.

(f) For each occupant permitted in a lower deck service compartment, there must be a forward or aft facing seat which meets the requirements of § 25.785(c) and must be able to withstand maximum flight loads when occupied.

of this section, or both are open.

(2) An emergency stop button, that when activated will immediately stop the lift, must be installed within the lift and at each entrance to the lift.

(3) There must be a hatch capable of being used for evacuating persons from the lift that is openable from inside and outside the lift without tools, with the lift in any position.

(Amdt. 25–53, Eff. 8/31/80)

VENTILATION AND HEATING

§ 25.831 Ventilation.

(a) Each passenger and crew compartment must be ventilated, and each crew compartment must have enough fresh air (but not less than 10 cu. ft. per minute per crewmember) to enable crewmembers to perform their duties without undue discomfort or fatigue.

(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapors. In meeting this requirement, the following apply:

(1) Carbon monoxide concentrations in excess of one part in 20,000 parts of air are considered hazardous. For test purposes, any acceptable carbon monoxide detection method may be used.

(2) Carbon dioxide in excess of three percent by volume (sea level equivalent) is considered hazardous in the case of crewmembers. Higher concentrations of carbon dioxide may be allowed in crew compartments if appropriate protective breathing equipment is available.

(c) There must be provisions made to ensure that the conditions prescribed in paragraph (b) of this section are met after reasonably probable failures or malfunctioning of the ventilating, heating, pressurization, or other systems and equipment.

(d) If accumulation of hazardous quantities of smoke in the cockpit area is reasonably probable, smoke evacuation must be readily accomplished, starting with full pressurization and without depressurizing beyond safe limits.

than the flight crew compartment unless the crewmember compartment or area is ventilated by air interchange with other compartments or areas under all operating conditions.

(f) Means to enable the flight crew to control the temperature and quantity of ventilating air supplied to the flight crew compartment independently of the temperature and quantity of ventilating air supplied to other compartments are not required if all of the following conditions are met:

(1) The total volume of the flight crew and passenger compartments is 800 cubic feet or less.

(2) The air inlets and passages for air to flow between flight crew and passenger compartments are arranged to provide compartment temperatures within 5 degrees F. of each other and adequate ventilation to occupants in both compartments.

(3) The temperature and ventilation controls are accessible to the flight crew.

(Amdt. 25–41, Eff. 9/1/77)

§ 25.832 Cabin ozone concentration.

(a) The airplane cabin ozone concentration during flight must be shown not to exceed—

(1) 0.25 parts per million by volume, sea level equivalent, at any time above flight level 320; and

(2) 0.01 parts per million by volume, sea level equivalent, time-weighted average during any 3-hour interval above flight level 270.

(b) For the purpose of this section, "sea level equivalent" refers to conditions of 25 °C and 760 millimeters of mercury pressure.

(c) Compliance with this section must be shown by analysis or tests based on airplane operational procedures and performance limitations, that demonstrate that either—

(1) The airplane cannot be operated at an altitude which would result in cabin ozone concentrations exceeding the limits prescribed by paragraph (a) of this section; or

(2) The airplane ventilation system, including any ozone control equipment, will maintain cabin

PRESSURIZATION

§ 25.841 Pressurized cabins.

(a) Pressurized cabins and compartments to be occupied must be equipped to provide a cabin pressure altitude of not more than 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions. If certification for operation over 25,000 feet is requested, the airplane must be able to maintain a cabin pressure altitude of not more than 15,000 feet in the event of any reasonably probable failure or malfunction in the pressurization system.

(b) Pressurized cabins must have at least the following valves, controls, and indicators for controlling cabin pressure:

(1) Two pressure relief valves to automatically limit the positive pressure differential to a predetermined value at the maximum rate of flow delivered by the pressure source. The combined capacity of the relief valves must be large enough so that the failure of any one valve would not cause an appreciable rise in the pressure differential. The pressure differential is positive when the internal pressure is greater than the external.

(2) Two reverse pressure differential relief valves (or their equivalents) to automatically prevent a negative pressure differential that would damage the structure. One valve is enough, however, if it is of a design that reasonably precludes its malfunctioning.

(3) A means by which the pressure differential can be rapidly equalized.

(4) An automatic or manual regulator for controlling the intake or exhaust airflow, or both, for maintaining the required internal pressures and airflow rates.

(5) Instruments at the pilot or flight engineer station to show the pressure differential, the cabin pressure altitude, and the rate of change of the cabin pressure altitude.

(6) Warning indication at the pilot or flight engineer station to indicate when the safe or preset pressure differential and cabin pressure alti-

(7) A warning placard at the pilot or flight engineer station if the structure is not designed for pressure differentials up to the maximum relief value setting in combination with landing loads.

(8) The pressure sensors necessary to meet the requirements of paragraphs (b)(5) and (b)(6) of this section and § 25.1447(c), must be located and the sensing system designed so that, in the event of loss of cabin pressure in any passenger or crew compartment (including upper and lower lobe galleys), the warning and automatic presentation devices, required by those provisions, will be actuated without any delay that would significantly increase the hazards resulting from decompression.

(Amdt. 25–38, Eff. 2/1/77)

§ 25.843 Test for pressurized cabins.

(a) *Strength test.* The complete pressurized cabin, including doors, windows, and valves, must be tested as a pressure vessel for the pressure differential specified in § 25.365(d).

(b) *Functional tests.* The following functional tests must be performed:

(1) Tests of the functioning and capacity of the positive and negative pressure differential valves, and of the emergency release valve, to stimulate the effects of closed regulator valves.

(2) Tests of the pressurization system to show proper functioning under each possible condition of pressure, temperature, and moisture, up to the maximum altitude for which certification is requested.

(3) Flight tests, to show the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals, in steady and stepped climbs and descents at rates corresponding to the maximum attainable within the operating limitations of the airplane, up to the maximum altitude for which certification is requested.

(4) Tests of each door and emergency exit, to show that they operate properly after being subjected to the flight tests prescribed in paragraph (b)(3) of this section.

Passenger Capacity	*Number of Extinguishers*
7 through 30	1
31 through 60	2
61 through 200	3
201 through 300	4
301 through 400	5
401 through 500	6
501 through 600	7
601 through 700	8

(2) At least one hand fire extinguisher must be conveniently located in the pilot compartment.

(3) At least one readily accessible hand fire extinguisher must be available for use in each Class A or Class B cargo or baggage compartment and in each Class E cargo or baggage compartment that is accessible to crewmembers in flight.

(4) At least one hand fire extinguisher must be located in, or readily accessible for use in, each galley located above or below the passenger compartment.

(5) Each hand fire extinguisher must be approved.

(6) At least one of the required fire extinguishers located in the passenger compartment of an airplane with a passenger capacity of at least 31 and not more than 60, and at least two of the fire extinguishers located in the passenger compartment of an airplane with a passenger capacity of 61 or more must contain Halon 1211 (bromochlorodifluoromethane $CBrC_1F_2$), or equivalent, as the extinguishing agent. The type of extinguishing agent used in any other extinguisher required by the section must be appropriate for the kinds of fires likely to occur where used.

(7) The quantity of extinguishing agent used in each extinguisher required by this section must be appropriate for the kinds of fires likely to occur where used.

(8) Each extinguisher intended for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentration.

(b) *Built-in fire extinguishers.* If a built-in fire extinguisher is provided—

extinguishing system must be adequate for any fire likely to occur in the compartment where used, considering the volume of the compartment and the ventilation rate.

(Amdt. 25–54, Eff. 10/14/80); (Amdt. 25–72, Eff. 8/20/90); (Amdt. 25–74, Eff. 5/16/91)

§ 25.853 Compartment interiors.

[For each compartment occupied by the crew or passengers, the following apply:

[(a) Materials (including finishes or decorative surfaces applied to the materials) must meet the applicable test criteria prescribed in part I of appendix F of this part, or other approved equivalent methods, regardless of the passenger capacity of the airplane.

[(b) [Reserved]

[(c) In addition to meeting the requirements of paragraph (a) of this section, seat cushions, except those on flight crewmember seats, must meet the test requirements of part II of appendix F of this part, or other equivalent methods, regardless of the passenger capacity of the airplane.

[(d) Except as provided in paragraph (e) of this section, the following interior components of airplanes with passenger capacities of 20 or more must also meet the test requirements of parts IV and V of appendix F of this part, or other approved equivalent method, in addition to the flammability requirements prescribed in paragraph (a) of this section:

[(1) Interior ceiling and wall panels, other than lighting lenses and windows;

[(2) Partitions, other than transparent panels needed to enhance cabin safety;

[(3) Galley structure, including exposed surfaces of stowed carts and standard containers and the cavity walls that are exposed when a full complement of such carts or containers is not carried; and

[(4) Large cabinets and cabin stowage compartments, other than underseat stowage compartments for stowing small items such as magazines and maps.

If smoking is to be allowed in any other compartment occupied by the crew or passengers, an adequate number of self-contained, removable ashtrays must be provided for all seated occupants.

[(g) Regardless of whether smoking is allowed in any other part of the airplane, lavatories must have self-contained, removable ashtrays located conspicuously on or near the entry side of each lavatory door, except that one ashtray may serve more than one lavatory door if the ashtray can be seen readily from the cabin side of each lavatory served.

[(h) Each receptacle used for the disposal of flammable waste material must be fully enclosed, constructed of at least fire resistant materials, and must contain fires likely to occur in it under normal use. The capability of the receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test.]

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–17, Eff. 6/20/68); (Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–51, Eff. 3/6/80); (Amdt. 25–59, Eff. 11/26/84); (Amdt. 25–60, Eff. 6/16/86); (Amdt. 25–61, Eff. 8/20/86); (Amdt. 25–66, Eff. 9/26/88); (Amdt. 25–72, Eff. 8/20/90); [(Amdt. 25–83, Eff. 3/6/95)]

§ 25.854 Lavatory fire protection.

For airplanes with a passenger capacity of 20 or more:

(a) Each lavatory must be equipped with a smoke detector system or equivalent that provides a warning light in the cockpit, or provides a warning light or audible warning in the passenger cabin that would be readily detected by a flight attendant; and

(b) Each lavatory must be equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste, located within the lavatory. The extinguisher must be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in that receptacle.

(Amdt. 25–74, Eff. 5/16/91)

and the liner must be separate from (but may be attached to) the airplane structure.

(c) Ceiling and sidewall liner panels of Class C and D compartments must meet the test requirements of part III of appendix F of this part or other approved equivalent methods.

(d) All other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in part I of appendix F of this part or other approved equivalent methods.

(e) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—

(1) They cannot be damaged by the movement of cargo in the compartment, and

(2) Their breakage or failure will not create a fire hazard.

(f) There must be means to prevent cargo or baggage from interfering with the functioning of the fire protective features of the compartment.

(g) Sources of heat within the compartment must be shielded and insulated to prevent igniting the cargo or baggage.

(h) Flight tests must be conducted to show compliance with the provisions of § 25.857 concerning—

(1) Compartment accessibility,

(2) The entries of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers, and

(3) The dissipation of the extinguishing agent in Class C compartments.

(i) During the above tests, it must be shown that no inadvertent operation of smoke or fire detectors in any compartment would occur as a result of fire contained in any other compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously.

(Amdt. 25–15, Eff. 10/24/67); (Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–60, Eff. 6/16/86); (Amdt. 25–72, Eff. 8/20/90)

(b) *Class B.* A Class B cargo or baggage compartment is one in which—

(1) There is sufficient access in flight to enable a crew member to effectively reach any part of the compartment with the contents of a hand fire extinguisher;

(2) When the access provisions are being used, no hazardous quantity of smoke, flames or extinguishing agent, will enter any compartment occupied by the crew or passengers;

(3) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station.

(c) *Class C.* A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which—

(1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station;

(2) There is an approved built-in fire extinguishing system controllable from the pilot or flight engineer stations;

(3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;

(4) There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the compartment.

(d) *Class D.* A Class D cargo or baggage compartment is one in which—

(1) A fire occuring in it will be completely confined without endangering the safety of the airplane or the occupants;

(2) There are means to exclude hazardous quantities of smoke, flames, or other noxious gases, from any compartment occupied by the crew or passengers.

(3) Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits; and

(4) [Reserved]

and in which—

(1) [Reserved]

(2) There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station;

(3) There are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;

(4) There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment; and

(5) The required crew emergency exits are accessible under any cargo loading condition.

(Amdt. 25–32, Eff. 5/1/72); (Amdt. 25–60, Eff. 6/16/86)

§ 25.858 Cargo compartment fire detection systems.

If certification with cargo compartment fire detection provisions is requested, the following must be met for each cargo compartment with those provisions:

(a) The detection system must provide a visual indication to the flight crew within one minute after the start of a fire.

(b) The system must be capable of detecting a fire at a temperature significantly below that at which the structural integrity of the airplane is substantially decreased.

(c) There must be means to allow the crew to check in flight, the functioning of each fire detector circuit.

(d) The effectiveness of the detection system must be shown for all approved operating configurations and conditions.

(Amdt. 25–54, Eff. 10/14/80)

§ 25.859 Combustion heater fire protection.

(a) *Combustion heater fire zones.* The following combustion heater fire zones must be protected from fire in accordance with the applicable provisions of §§ 25.1181 through 25.1191 and §§ 25.1195 through 25.1203;

heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region.

(3) The part of the ventilating air passage that surrounds the combustion chamber. However, no fire extinguishment is required in cabin ventilating air passages.

(b) *Ventilating air ducts.* Each ventilating air duct passing through any fire zone must be fireproof. In addition—

(1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct; and

(2) Each part of any ventilating duct passing through any region having a flammable fluid system must be constructed or isolated from that system so that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.

(c) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition—

(1) No combustion air duct may have a common opening with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunctioning of the heater or its associated components; and

(2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.

(d) *Heater controls; general.* Provision must be made to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.

(e) *Heater safety controls.* For each combustion heater there must be the following safety control means:

(1) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be pro-

equate for safe operation.

(iv) The ventilating airflow becomes inadequate for safe operation.

(2) The means of complying with subparagraph (e)(1) of this section for any individual heater must—

(i) Be independent of components serving any other heater whose heat output is essential for safe operation; and

(ii) Keep the heater off until restarted by the crew.

(3) There must be means to warn the crew when any heater whose heat output is essential for safe operation has been shut off by the automatic means prescribed in paragraph (e)(1) of this section.

(f) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system under any operating condition—

(1) During normal operation; or

(2) As a result of the malfunctioning of any other component.

(g) *Heater exhaust.* Heater exhaust systems must meet the provisions of §§ 25.1121 and 25.1123. In addition, there must be provisions in the design of the heater exhaust system to safely expel the products of combustion to prevent the occurrence of—

(1) Fuel leakage from the exhaust to surrounding compartments;

(2) Exhaust gas impingement on surrounding equipment or structure;

(3) Ignition of flammable fluids by the exhaust, if the exhaust is in a compartment containing flammable fluid lines; and

(4) Restriction by the exhaust of the prompt relief of backfires that, if so restricted, could cause heater failure.

(h) *Heater fuel systems.* Each heater fuel system must meet each powerplant fuel system requirement affecting safe heater operation. Each heater fuel system component within the ventilating airstream must be protected by shrouds so that no leakage ous ice accumulation under any operating condition.

(Amdt. 25–11, Eff. 6/4/67); (Amdt. 25–23, Eff. 5/8/70)

§ 25.863 Flammable fluid fire protection.

(a) In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur.

(b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered:

(1) Possible sources and paths of fluid leakage, and means of detecting leakage.

(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.

(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.

(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

(5) Ability of airplane components that are critical to safety of flight to withstand fire and heat.

(c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.

(d) Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.

(Amdt. 25–23, Eff. 5/8/70); (Amdt. 25–46, Eff. 12/1/78)

§ 25.865 Fire protection of flight controls, engine mounts, and other flight structure.

Essential flight controls, engine mounts, and other flight structures located in designated fire zones one nacelle diameter of the nacelle centerline, must be at least fire-resistant.

(b) Paragraph (a) of this section does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.869 Fire protection: Systems.

(a) Electrical system components:

(1) Components of the electrical system must meet the applicable fire and smoke protection requirements of §§ 25.831(c) and 25.863.

(2) Electrical cables, terminals, and equipment in designated fire zones, that are used during emergency procedures, must be at least fire resistant.

(3) Main power cables (including generator cables) in the fuselage must be designed to allow a reasonable degree of deformation and stretching without failure and must be—

(i) Isolated from flammable fluid lines; or

(ii) Shrouded by means of electrically insulated, flexible conduit, or equivalent, which is in addition to the normal cable insulation.

(4) Insulation on electrical wire and electrical cable installed in any area of the fuselage must be self-extinguishing when tested in accordance

(c) Oxygen equipment and lines must—

(1) Not be located in any designated fire zone,

(2) Be protected from heat that may be generated in, or escape from, any designated fire zone, and

(3) Be installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapor accumulations that are present in normal operation or as a result of failure or malfunction of any system.

(Amdt. 25–72, Eff. 8/20/90)

MISCELLANEOUS

§ 25.871 Leveling means.

There must be means for determining when the airplane is in a level position on the ground.

(Amdt. 25–23, Eff. 5/8/70)

§ 25.875 Reinforcement near propellers.

(a) Each part of the airplane near the propeller tips must be strong and stiff enough to withstand the effects of the induced vibration and of ice thrown from the propeller.

(b) No window may be near the propeller tips unless it can withstand the most severe ice impact likely to occur.

flow of air passes. The specimen's exposure is determined by a radiant heat source adjusted to produce, on the specimen, the desired total heat flux of 3.5 W/cm^2. The specimen is tested with the exposed surface vertical. Combustion is initiated by piloted ignition. The combustion products leaving the chamber are monitored in order to calculate the release rate of heat.]

(b) *Apparatus.* The Ohio State University (OSU) rate of heat release apparatus, as described below, is used. This is a modified version of the rate of heat release apparatus standardized by the American Society of Testing and Materials (ASTM), ASTM E–906.

(1) [This apparatus is shown in Figures 1A and 1B of this part IV. All exterior surfaces of the apparatus, except the holding chamber, must be insulated with 1 inch (25 mm) thick, low density, high temperature, fiberglass board insulation. A gasketed door, through which the sample injection rod slides, must be used to form an airtight closure on the specimen hold chamber.

(2) [*Thermopile.* The temperature difference between the air entering the environmental chamber and that leaving must be monitored by a thermopile having five hot, and five cold, 24-gauge Chromel-Alumel junctions. The hot junctions must be spaced across the top of the exhaust stack, .38 inches (10 mm) below the top of the chimney. The thermocouples must have a .050 ± .010 inch (1.3 ± .3 mm) diameter, ball-type, welded tip. One thermocouple must be located in the geometric center, with the other four located 1.18 inch (30 mm) from the center along the diagonal toward each of the corners (Figure 5 of this part IV). The cold junctions must be located in the pan below the lower air distribution plate (see paragraph (b)(4) of this part IV). Thermopile hot junctions must be cleared of soot deposits as needed to maintain the calibrated sensitivity.

(3) [*Radiation Source.* A radiant heat source incorporating four Type LL silicon carbide elements, 20 inches (508 mm) long by .63 inch (16 mm) O.D., must be used, as shown in Figures 2A and 2B of this part IV. The heat source ing them through .63 inch, (16 mm) holes in .03 inch (1 mm) thick ceramic fiber or calcium-silicate millboard. Locations of the holes in the pads and stainless steel cover plates are shown in Figure 2B of this part IV. The truncated diamond-shaped mask of .042 ± .002 inch (1.07 ± .05 mm) stainless steel must be added to provide uniform heat flux density over the area occupied by the vertical sample.

(4) [*Air Distribution System.* The air entering the environmental chamber must be distributed by a .25 inch (6.3 mm) thick aluminum plate having eight No. 4 drill-holes, located 2 inches (51 mm) from sides on 4 inch (102 mm) centers, mounted at the base of the environmental chamber. A second plate of 18 gauge stainless steel having 120, evenly spaced, No. 28 drill holes must be mounted 6 inches (152 mm) above the aluminum plate. A well-regulated air supply is required. The air-supply manifold at the base of the pyramidal section must have 48, evenly spaced, No. 26 drill holes located .38 inch (10 mm) from the inner edge of the manifold, resulting in an airflow split of approximately three to one within the apparatus.

(5) [*Exhaust Stack.* An exhaust stack, 5.25 × 2.75 inches (133 × 70 mm) in cross section, and 10 inches (254 mm) long, fabricated from 28 gauge stainless steel must be mounted on the outlet of the pyramidal section. A 1.0 × 3.0 inch (25 × 76 mm) baffle plate of .018 ± .002 inch (.50 ± .05 mm) stainless steel must be centered inside the stack, perpendicular to the air flow, 3 inches (76 mm) above the base of the stack.

(6) [*Specimen Holders.* (i) The specimen must be tested in a vertical orientation. The specimen holder (Figure 3 of this part IV) must incorporate a frame that touches the specimen (which is wrapped with aluminum foil as required by paragraph (d)(3) of this part) along only the .25 inch (6 mm) perimeter. A "V" shaped spring is used to hold the assembly together. A detachable .50 × .50 × 5.91 inch (12 × 12 × 150 mm) drip pan and two .020 inch (.5 mm) stainless steel wires (as shown in figure 3 of this part IV)

into a slotted metal plate on the injection mechanism outside of the holding chamber. It can be used to provide accurate positioning of the specimen face after injection. The front surface of the specimen must be 3.9 inches (100 mm) from the closed radiation doors after injection.

[(iii) The specimen holder clips onto the mounted bracket (Figure 3 of this part IV). The mounting bracket must be attached to the injection rod by three screws that pass through a wide-area washer welded onto a 1/2-inch (13 mm) nut. The end of the injection rod must be threaded to screw into the nut, and a .020 inch (5.1 mm) thick wide area washer must be held between two 1/2-inch (13 mm) nuts that are adjusted to tightly cover the hole in the radiation doors through which the injection rod or calibration calorimeter pass.]

(7) *Calorimeter.* A total-flux flush calorimeter must be mounted in the center of a ½-inch Kaowool "M" board inserted in the sample holder to measure the total heat flux. The calorimeter must have a view angle of 180 degrees and be calibrated for incident flux. The calorimeter calibration must be acceptable to the Administrator.

(8) *Pilot-Flame Positions.* [Pilot ignition of the specimen must be accomplished by simultaneously exposing the specimen to a lower pilot burner and an upper pilot burner, as described in paragraph (b)(8)(i) and (b)(8)(ii) or (b)(8)(iii) of this part IV, respectively. Since intermittent pilot flame extinguishment for more than 3 seconds would invalidate the test results, a spark ignitor may be installed to ensure that the lower pilot burner remains lighted.

(i) *Lower Pilot Burner.* [The pilot-flame tubing must be .25 inch (6.3 mm) O.D., .03 inch (0.8 mm) wall, stainless steel tubing. A mixture of 120 cm³/min. of methane and 850 cm³/min. of air must be fed to the lower pilot flame burner. The normal position of the end of the pilot burner tubing is .40 inch (10 mm) from and perpendicular to the exposed vertical surface of the specimen. The centerline at the tubing must be closed, and three No. 40 drill holes must be drilled into the tubing, 2.38 inch (60 mm) apart, for gas ports, all radiating in the same direction. The first hole must be .19 inch (5 mm) from the closed end of the tubing. The tube must be positioned .75 inch (19 mm) above and .75 inch (19 mm) behind the exposed upper edge of the specimen. The middle hole must be in the vertical plane perpendicular to the exposed surface of the specimen which passes through its vertical centerline and must be pointed toward the radiation source. The gas supplied to the burner must be methane and must be adjusted to produce flame lengths of 1 inch (25 mm).

[(iii) *Optional Fourteen-Hole Upper Pilot Burner.* This burner may be used in lieu of the standard three-hole burner described in paragraph (b)(8)(ii) of this part IV. The pilot burner must be a straight length of .25 inch (6.3 mm) O.D., .03 inch (0.8 mm) wall, stainless steel tubing that is 15.75 inches (400 mm) long. One end of the tubing must be closed, and 14 No. 59 drill holes must be drilled into the tubing, .50 inch (13 mm) apart, for gas ports, all radiating in the same direction. The first hole must be .50 inch (13 mm) from the closed end of the tubing. The tube must be positioned above the specimen holder so that the holes are placed above the specimen as shown in Figure 1B of this part IV. The fuel supplied to the burner must be methane mixed with air in a ratio of approximately 50/50 by volume. The total gas flow must be adjusted to produce flame lengths of 1 inch (25 mm). When the gas/air ratio and the flow rate are properly adjusted, approximately .25 inch (6 mm) of the flame length appears yellow in color.]

(c) *Calibration of Equipment. (1) Heat Release Rate.* [A calibration burner, as shown in Figure 4, must be placed over the end of the lower pilot flame tubing using a gas tight connection. The flow of gas to the pilot flame must be at least 99 percent methane and must be accurately metered. Prior to usage, the wet test meter must be properly leveled the chamber. This is not recorded as part of calibration. The rate must be determined by using a stopwatch to time a complete revolution of the wet test meter for both the baseline and higher flow, with the flow returned to baseline before changing to the next higher flow. The thermopile baseline voltage must be measured. The gas flow to the burner must be increased to the higher preset flow and allowed to burn for 2.0 minutes, and the thermopile voltage must be measured. The sequence must be repeated until all five values have been determined. The average of the five values must be used as the calibration factor. The procedure must be repeated if the percent relative standard deviation is greater than 5 percent. Calculations are shown in paragraph (f) of this part IV.]

(2) *Flux Uniformity*. Uniformity of flux over the specimen must be checked periodically and after each heating element change to determine if it is within acceptable limits of plus or minus 5 percent.

[(3) As noted in paragraph (b)(2) of this part IV, thermopile hot junctions must be cleared of soot deposits as needed to maintain the calibrated sensitivity.]

(d) *Preparation of Test Specimens*. [(1) The test specimens must be representative of the aircraft component in regard to materials and construction methods. The standard size for the test specimens is 5.91 ± .03 × 5.91 ± .03 inches (149 ± 1 × 149 ± 1 mm). The thickness of the specimen must be the same as that of the aircraft component it represents up to a maximum thickness of 1.75 inches (45 mm). Test specimens representing thicker components must be 1.75 inches (45 mm).]

(2) *Conditioning*. Specimens must be conditioned as described in part 1 of this appendix.

(3) *Mounting*. [Each test specimen must be wrapped tightly on all sides of the specimen, except for the one surface that is exposed during the test, with a single layer of .001 inch (.025 mm) aluminum foil.]

(e) *Procedure*. (1) [The power supply to the radiant panel must be set to produce a radiant flux of 3.5 ± .05 W/cm^2, as measured at the point the center of the specimen surface will occupy when

a 1.5 inch (38.1 mm) I.D. pipe with two pressure measuring points, located 1.5 inches (38 mm) upstream and .75 inches (19 mm) downstream of the orifice plate. The pipe must be connected to a manometer set at a pressure differential of 7.87 inches (200 mm) of Hg. (See Figure 1B of this part IV.) The total air flow to the equipment is approximately .04 m^3/seconds. The stop on the vertical specimen holder rod must be adjusted so that the exposed surface of the specimen is positioned 3.9 inches (100 mm) from the entrance when injected into the environmental chamber.

(4) [The specimen must be placed in the hold chamber with the radiation doors closed. The airtight outer door must be secured, and the recording devices must be started. The specimen must be retained in the hold chamber for 60 seconds, plus or minus 10 seconds, before injection. The thermopile "zero" value must be determined during the last 20 seconds of the hold period. The sample must not be injected before completion of the "zero" value determination.

(5) [When the specimen is to be injected, the radiation doors must be opened. After the specimen is injected into the environmental chamber, the radiation doors must be closed behind the specimen.]

(6) [Reserved]

(7) Injection of the specimen and closure of the inner door marks time zero. A record of the thermopile output with at least one data point per second must be made during the time the specimen is in the environmental chamber.

(8) [The test duration is five minutes. The lower pilot burner and the upper pilot burner must remain lighted for the entire duration of the test, except that there may be intermittant flame extinguishment for periods that do not exceed 3 seconds. Furthermore, if the optional three-hole upper burner is used, at least two flamelets must remain lighted for the entire duration of the test, except that there may be intermittant flame extinguishment of all three flamelets for periods that do not exceed 3 seconds.

F_0=flow of methane at baseline (1pm)
F_1=higher preset flow of methane (1pm)
V_0=thermopile voltage at baseline (mv)
V_1=thermopile voltage at higher flow (mv)
T_a=Ambient temperature (K)
P=Ambient pressure (mm Hg)
P_v=Water vapor pressure (mm Hg)

(2) [Heat release rates may be calculated from the reading of the thermopile output voltage at any instant of time as:

$$HRR=\frac{(V_m-V_b)\,K_h}{.02323\ m^2}$$

HRR=heat release rate (kw/m^2)
V_b=baseline voltage (mv)
V_m=measured thermopile voltage (mv)
K_h=calibration factor (kw/mv)]

(3) The integral of the heat release rate is the total heat release as a function of time and is calculated by multiplying the rate by the data sampling frequency in minutes and summing the time from zero to two minutes.

(g) *Criteria.* The total positive heat release over the first two minutes of exposure for each of the three or more samples tested must be averaged, and the peak heat release rate for each of the samples must be averaged. The average total heat release must not exceed 65 kilowatt-minutes per square meter, and the average peak heat release rate must not exceed 65 kilowatts per square meter.

(h) *Report.* The test report must include the following for each specimen tested:

(1) Description of the specimen.

(2) Radiant heat flux to the specimen, expressed in W/cm^2.

(3) Data giving release rates of heat (in kW/m_2) as a function of time, either graphically or tabulated at intervals no greater than 10 seconds. The calibration factor (k_n) must be recorded.

(4) If melting, sagging, delaminating, or other behavior that affects the exposed surface area or the mode of burning occurs, these behaviors must be reported, together with the time at which such behaviors were observed.

(5) The peak heat release and the 2 minute integrated heat release rate must be reported.

[Figures to part IV of Appendix F]

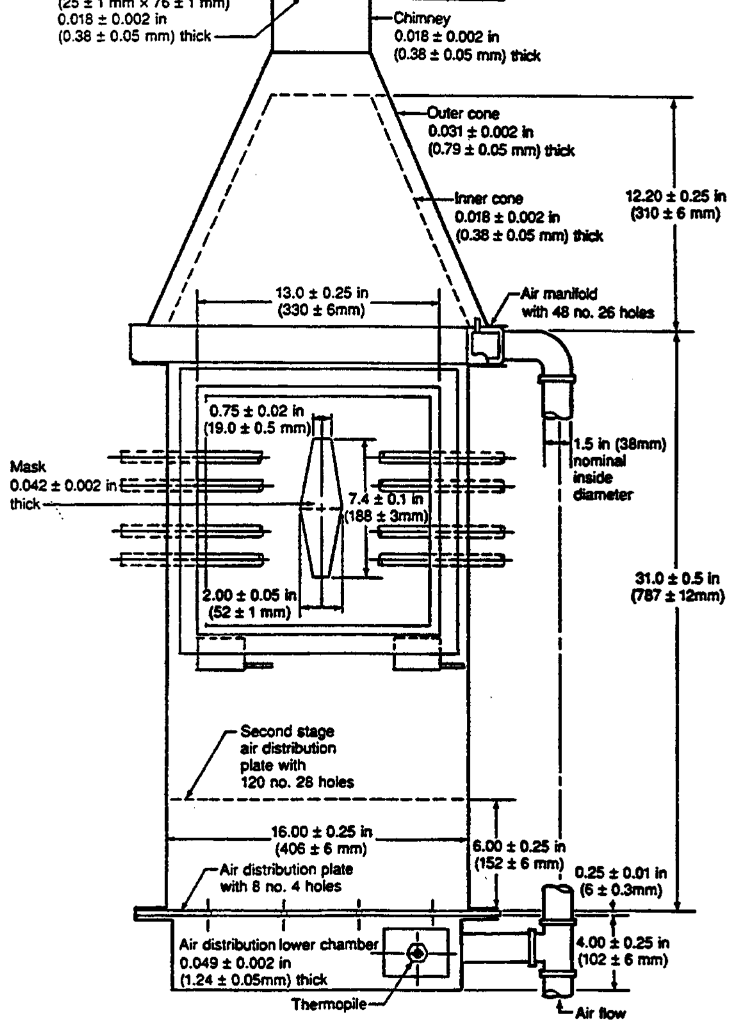


Figure 1A. Rate of Heat Release Apparatus

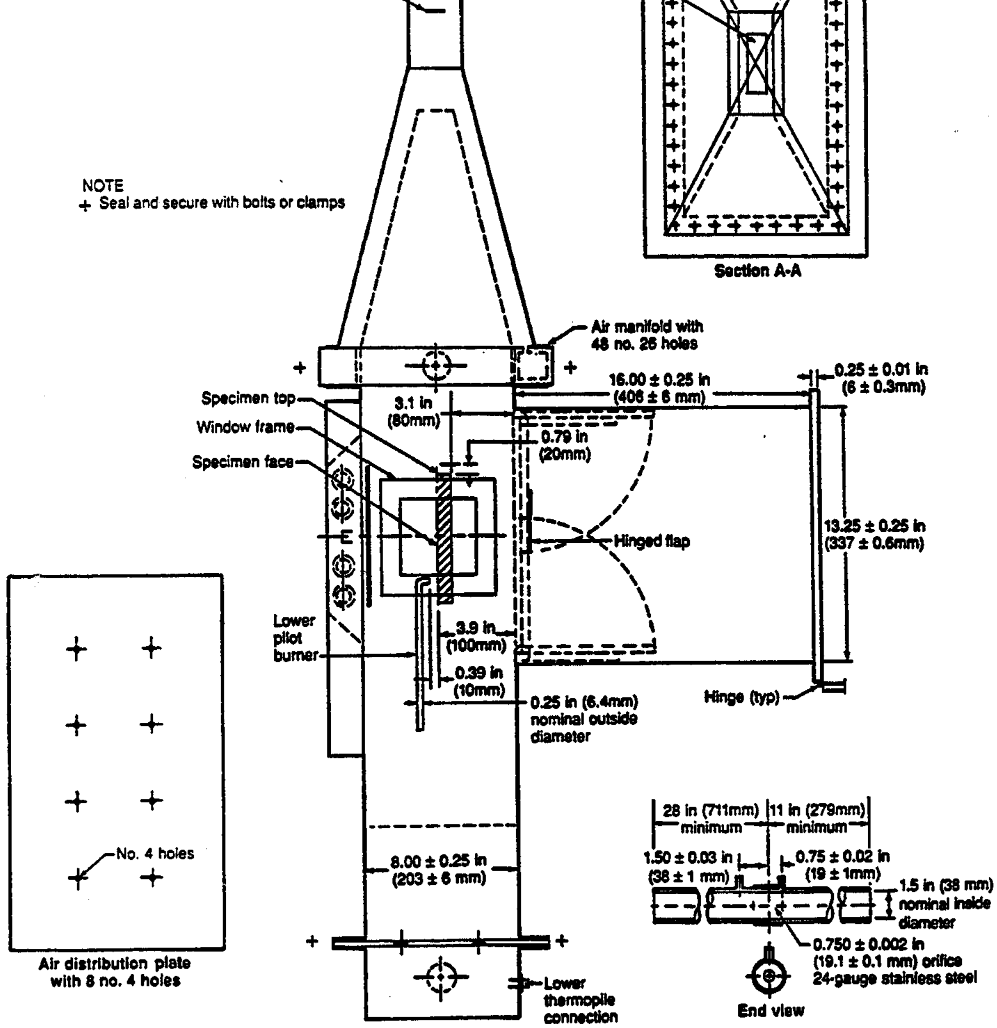
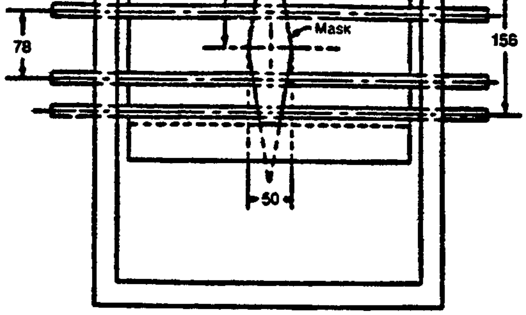
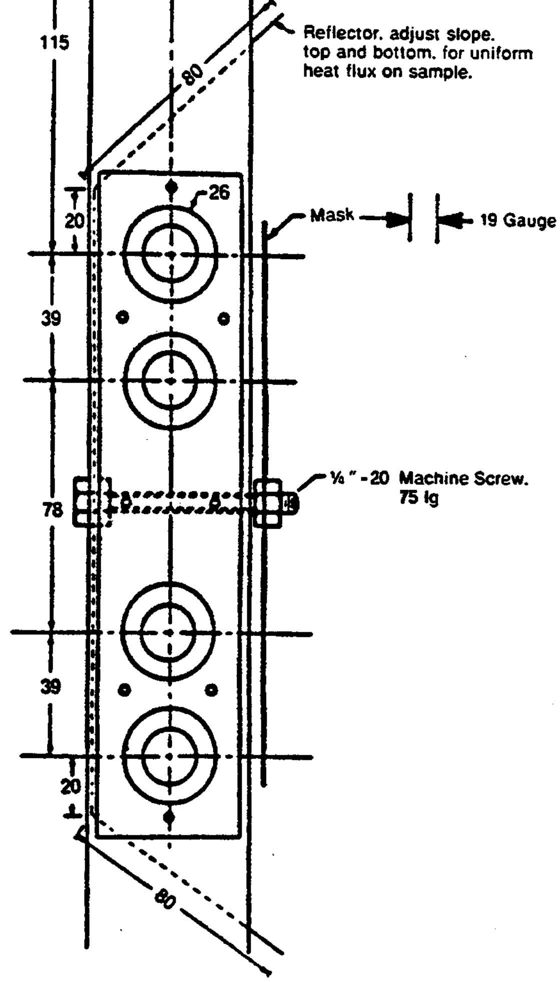


Figure 1B. Rate of Heat Release Apparatus



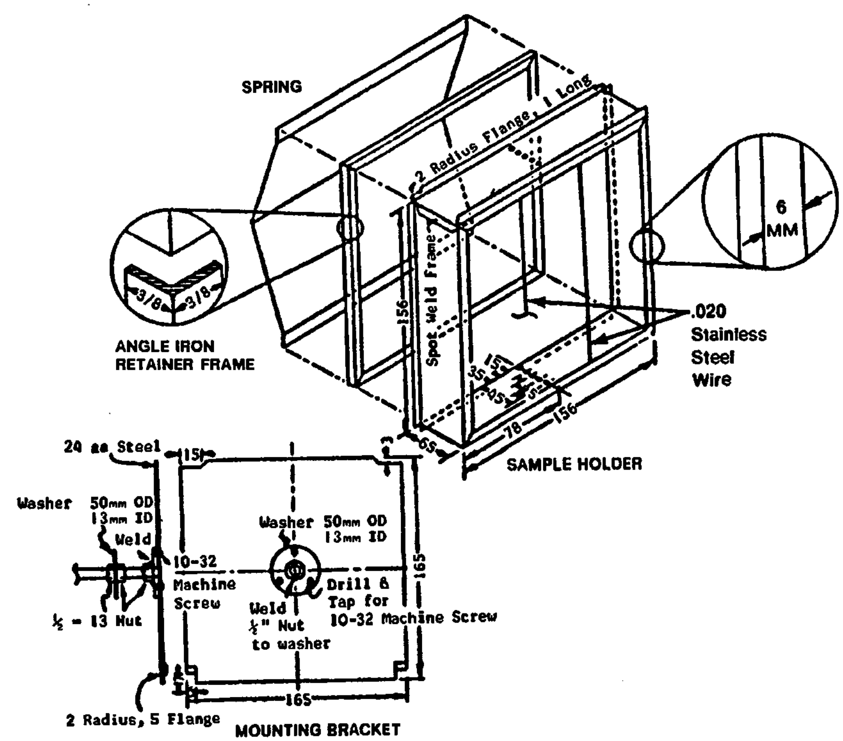
(Unless denoted otherwise all dimensions are in milimeters.)

Figure 2A. "Globar" Radiant Panel



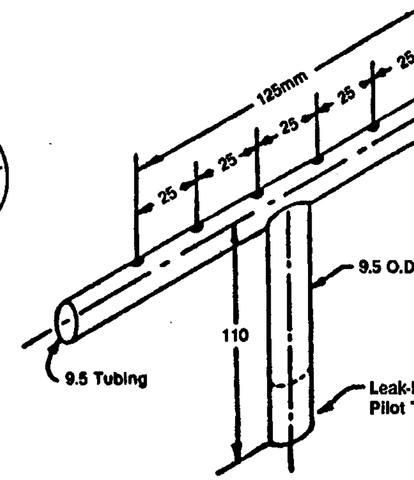
(Unless denoted otherwise all dimensions are in milimeters.)

Figure 2B. "Globar" Radiant Panel



(Unless denoted otherwise, all dimensions are in millimeters.)

Figure 3.



(Unless denoted otherwise, all dimensions

Figure 4.

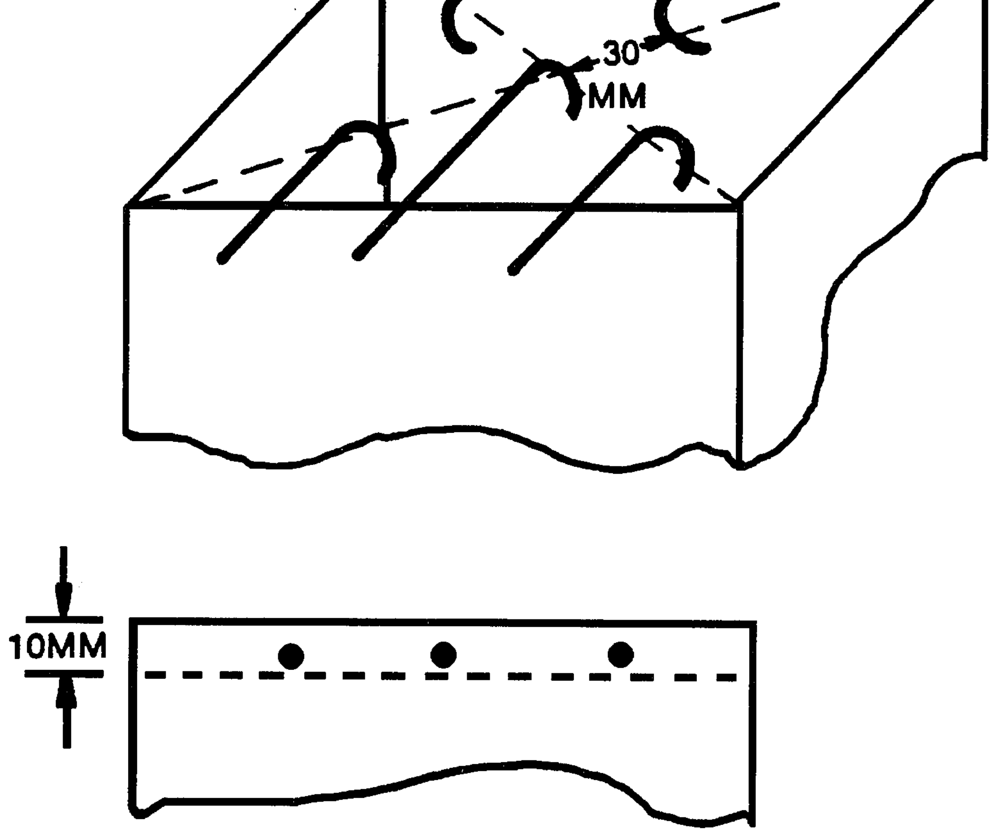


Figure 5. Thermocouple Position

ing and Materials (ASTM) Standard Test Method ASTM F814–83.

(b) *Acceptance Criteria.* The specific optical smoke density (D_S), which is obtained by averaging

3/1/72); (Amdt. 25–55, Eff. 4/28/82); (Amdt. 25–59, Eff. 11/26/84); (Amdt. 25–60, Eff. 6/16/86); (Amdt. 25–61, Eff. 8/20/86); (Amdt. 25–66, Eff. 9/26/88); (Amdt. 25–72, Eff. 8/20/90); **[**(Amdt. 25–83, Eff. 3/6/95)**]**

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